SCIENCE ABSTRACTS.

Section A.—PHYSICS.

NOVEMBER 1906.

GENERAL PHYSICS.

1806. *Harmonic Synthetiser.* **J. R. Milne.** (Roy. Soc. Edinburgh, Proc. 26. pp. 207–238, 1905–1906.)—This apparatus is designed for the purpose of drawing the curve which is the summation of a number of simple harmonics, and is so constructed that both the amplitude and the period of any of its constituent harmonics can be set to all values, commensurable or incommensurable, throughout their range; this can be effected while the machine is in motion. The movement of the pen used to register the curves obtained is not truly harmonic, but the error is small, and the author discusses mathematically the deviation from the truth.

A. W.

1807. *Effect of Deformation upon Torsional Couple Exerted by a Twisted Wire.* **G. Ercolini.** (Accad. Lincei, Atti, 15. pp. 296–305, Sept. 2, 1906.)—In a previous paper the effect of winding a wire on a steel cylinder, upon the elongation due to a stretching force is investigated [see Abstract No. 1660 (1906)]; in the present paper the effect of this winding upon the torsion of the wire is determined. As before the wire is copper, and four cylinders of 0·5, 1, 2, and 4 cm. diam. are employed. The cylinder is mounted so that in addition to turning about its own axis, which is horizontal, it can be rotated about a vertical axis coincident with the wire, and in this way exert a twisting couple upon it. The value of the couple is determined by attaching the lower end of the wire to the upper of two beams which are united by a bifilar connection, the lower beam being weighted and constrained to remain in constant azimuth. The relative positions of the beams gives for each vertical force a measure of the couple. It is found that on applying a couple and then winding the wire upon the cylinder by rotating the latter about its own axis, the couple decreases for successive turns of the cylinder, but most rapidly at first. On unwinding, the residual couple is generally greater than that before beginning the unwinding. Repeated operations produce increasing effects, but after the fifth the increase is very small, and the smaller the cylinder the more marked is the effect. The effect upon couples exerted alternately in opposite directions is found, and also the effect of drawing the wire through a draw-plate to reduce its diam.: the drawing of a small part of the length of the wire is sufficient to reduce the couple to zero.

The effect of applying a load sinusoidally when the twist in the wire is also applied sinusoidally, and of magnitude about 10 turns, or 3,600°, is investigated, when the torsion and traction have varying difference of phase. The general results are then summarised as follows:—(1) A deformation (bending, drawing, or traction) operating upon a portion of a twisted wire reduces the couple, sometimes to zero, the reduction being more rapid the greater the deformation; (2) subjecting a wire simultaneously to torsion and considerable traction, when the elongation begins to become great the couple diminishes and sometimes disappears, according to the relative phase of the two deformations, but as the elongation proceeds the wire hardens and the couple increases; (3) the greater the elongation produced by torsion alone in a stretched wire the less is the couple generated. S. G. S.

1808. *Alternate-stress Testing and Heat Treatment of Steels.* **J. E. Howard.** (Eng. Record, 54. pp. 334–336, Sept. 22, 1906. Abstract of paper read before the Brussels Congress of the Internat. Assoc. for Testing Materials.)—Gives results of some tests performed at Watertown Arsenal, the alternate-stress specimens being in the form of centrally loaded shafts rotating at 500 r.p.m. The carbon contents of the steels are from 0·17 to 0·82 per cent., and results of tensile tests are given. No steels were found to endure 100 million repetitions of stress above 40,000 lbs. per sq. in., but below this stress some withstood more than 150 million repetitions. Tests of annular specimens, made by cutting away the interiors of specimens broken in these tests, have shown higher strength than the fresh material. At 400° F. the endurance of steel is greater than at atmospheric temperature. Periodical annealing of the metal during test did not increase the endurance. Some tensile tests showing effects of heat treatment on a steel are added. F. R.

1809. *Effect of Combined Stresses on Iron and Steel.* **E. L. Hancock.** (Phil. Mag. 12. pp. 418–425, Oct., 1906. Paper read before the Amer. Soc. for Testing Materials, June, 1906.)—The author's combined tension and torsion experiments on tubular specimens show that the existence of a torsional stress lowers somewhat the tensional stress and strain at elastic limit, and also lowers the Young's modulus. The following are the figures for steel tubing of 1 in. external and 0·9 in. internal diam.:—

Torsional Stress.	Elastic Limit, Lbs. per sq. in.	Young's Modulus, Lbs. per sq. in.
0	28,000	29,700,000
⅓ Torsional elastic limit ...	24,000	27,800,000
⅔ ditto ...	17,000	25,000,000
Equal to ditto ...	14,000	16,200,000

[See also Abstract No. 2018 (1905).] F. R.

1810. *Tests of Metals in Reverse Torsion.* **E. L. Hancock.** (Phil. Mag. 12. pp. 426–430, Oct., 1906. Paper read before the Amer. Soc. for Testing Materials, June, 1906.)—The results of the author's experiments are in accord with those for tension and compression. When wrought iron or mild steel is stressed in torsion within its elastic limit its elastic properties in torsion in the opposite direction are not affected. If stressed originally slightly beyond the elastic limit, the elastic limit in the reverse direction is lowered, but not to zero, even if the stress is immediately reversed; the modulus is not affected. If stressed originally decidedly beyond the yield-point, the elasticity in the reverse direction is destroyed, but reappears gradually after rest. F. R.

1811. *Strength and Elasticity of White Metal.* **J. Goodman.** (Engineering, 82. p. 876, Sept. 21, 1906. Mech. Eng. 18. pp. 453–454, Sept. 29, 1906.)—The following table gives the results of tests of alloys, which are used in the construction of pumps required for dealing with acids, &c. Tensile and compression tests:—

Number.	Composition.			Elastic Limit, Tons per sq. in.		Maximum Stress, Tons per sq. in.		Young's Modulus, Tons per sq. in.		Contraction, per cent.	Elongation, per cent., in 10 in.
	Sb	Pb	Sn	Tension.	Compression.	Tension.	Compression.	Tension.	Compression.		
1	10	90	—	0·96	1·39	3·14	7·98	1700	1740	1·3	0·4
				1		3·32	7·20	1690		1·7	1·1
2	13	87	—	0·95	1·0	3·28	7·12	1780	1800	3·7	2·5
				0·90		3·10	7·31	1690			1·3
3	15	85	—	0·92	1·07	2·71	7·49	1750	1820	2·4	0·9
				0·92		3·07	7·49	1680			1·4
4	15	80	5	0·80	1·01	2·27	7·00	1830	1890	—	0·5
				0·83		2·80	6·95	1660			

The results of bending-tests of bars about 2 in. deep by 1 in. wide on 12-in. supports, loaded centrally, are given; and double shear tests of the ends of the broken beams. The shearing strength in tons per sq. in. ranges from 1·935 in the case of No. 4 to 2·285 for No. 1. F. R.

1812. *Plain and Reinforced Concrete Column Tests.* **J. E. Howard.** (Eng. News, 56. pp. 20–21, July 5, 1906. Paper read before the Amer. Soc. for Testing Materials, June, 1906. Eng. Record, 54. pp. 54–56, July 14, 1906.)—Gives results of a number of tests of columns 8 ft. long and 10 to 12 in. diam., of mortar or concrete, plain or reinforced in various ways. The results are in the order of their rigidity; the fact that plain concrete is more rigid than even longitudinally reinforced concrete seems to be best explained as the result of the formation of minute fissures in the latter during setting. The rigidity of neat cement and rich mortars is slightly less at low stresses after loading to high stresses. In the case of other mixtures the rigidity is greatly diminished, sometimes by more than 50 per cent. Measurements of lateral expansion of hooped columns showed adjacent hoops to be working under very different stresses. A warning of the point of fracture of plain columns is often given by the great lateral expansion occurring in the neighbourhood.
F. R.

1813. *Frictionless Orifice.* **H. Judd and R. S. King.** (Eng. News, 56. pp. 326–330, Sept. 27, 1906. Paper read before the Amer. Assoc. for the Advancement of Science, July, 1906. Slightly condensed.)—This series of experiments on frictionless orifices was undertaken for the purpose of

determining (1) the coefficient of discharge by calibration; (2) the shape of the jet in the vicinity of the least section; (3) the diam. of the jet at the least section; (4) the effect of increase in static pressure on the diam. at the least section, and the shape of the jet; (5) the velocity in the least section by use of the Pitot tube. Five orifices were used of nominal diam. 0·75, 1·0, 1·5, 2·0, and 2·5 in. Each orifice was made by boring out the proper size hole in a cast-iron plate, ¼ in. thick. The outer edge of the orifice was cut away at an angle of about 45°, so that the edge presented to the water was $\frac{1}{32}$ in. thick. Each orifice plate could be slipped into place and securely clamped in the end of a 24-in. drum, forming a smooth surface on the inside. The desired pressure at the orifice was maintained by means of two pumps, of combined capacity 1,150 galls. per min. The water as it came from the pumps was stored in a 24-in. vertical stand-pipe, 25 ft. high, at the bottom of which was fixed horizontally the drum, 48 in. long. The coefficient of discharge was computed by the usual formula $q = \mathrm{CA}\sqrt{2gh}$, where q is the quantity discharged by actual measurement, C the coefficient of discharge, A the area of orifice in sq. ft., and $\sqrt{2gh}$ the theoretical velocity equivalent to the static head h. Curves were plotted for the different orifices, and no great change in the coefficient of discharge was observed for increase in head, whilst both Merriman and Bovey give a decrease in the coefficient for increase in head. There is a decrease in the coefficient of about 2½ per cent., with increase in size of orifice from ¾ in. to 2½ in. This agrees fairly well with values given by Merriman and Bovey. The position of least diam. of the issuing jet depends on the size of the orifice, varying from 1·6 radii from the plane of the orifice for the ¾-in. orifice to 1 radius distance for the 2½-in. orifice, but the distance decreases less rapidly as the size increases. The coefficient of contraction was found to decrease with increase in the size of the orifice. The increase in static pressure seems to have little effect on the area at the least section, where there is no appreciable velocity of approach. The velocity was found to be uniform throughout the least section, and is equal to that corresponding to the static pressure within a negligible fraction of 1 per cent.
A. W.

1814. *Models of Atoms.* **A. W. Porter.** (Nature, 74. pp. 563–564, Oct. 4, 1906.)—A modification of Mayer's experiment with floating magnets is described. A small circular dish is filled with water almost to overflowing so that the surface is convex, the centripetal forces acting on the magnets being then due to capillarity. A single floating magnet, with axis vertical, moves towards the centre, and two or more form symmetrical figures which are not in general the same as in the ordinary arrangement. Ten magnets can be arranged in a ring without central nucleus, or with nine in a ring and one in the middle, or eight in the ring and two in the middle, but seven in the ring with three in the middle is not possible. Other arrangements are described.
S. G. S.

1815. *Experimental Determination of Surface Tension of Liquid Oxygen and Nitrogen.* **L. Grunmach.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 38. pp. 679–686, 1906. Phys. Zeitschr. 7. pp. 740–744; Discussion, p. 744, Oct. 25, 1906.)—The following are the author's results, the surface tension being determined by the capillary wave method [Abstract No. 17 (1901).] (1) *Liquid* *oxygen.*—Boiling-point at 762·22 mm. pressure, − 182·65°; surface tension, $\alpha = 13{\cdot}074 \pm 0{\cdot}066$ dynes/cm.; specific cohesion, $a^2 = 2\alpha/0 = 23{\cdot}038$ and molecular weight, 41·51. (2) *Liquid nitrogen.*—Boiling-point at 749·1 mm. pressure, − 195·9°; surface tension, $\alpha = 8{\cdot}514 \pm 0{\cdot}020$ dynes/cm.; specific cohesion, $a^2 = 21{\cdot}527$; molecular weight, 37·30. The above results are in good accord with those previously obtained with liquid air [Abstract No. 2070 (1901)]. It would appear that, when they pass into the liquid state, all simple substances undergo association, whilst compound ones do not. [See also Abstract No. 2758 (1904).] T. H. P.

1816. *Surface Tension by Method of Falling Drops.* **G. Guglielmo.** (Accad. Lincei, Atti, 15. pp. 287–295, Sept. 2, 1906.)—The surface tension of water is measured by the falling-drop method, the exact equation—

$$2\pi r T \cos\alpha = P + \pi r^2 p,$$

being used, where T is the surface tension, P the weight of the drop, r the radius of the least section, and p the difference of internal and external pressure. A method for measuring this difference of pressure (p) hydrostatically is employed. A thick-walled capillary tube is bent into an **S** shape, the upper aperture being that from which the drops fall, while the lower one consists of a funnel whose diam. is slightly greater than the greatest diam. of the drop, this being necessary for the stability of the arrangement. The edge of the funnel is ground plane and is horizontal, its level being slightly above that of the upper aperture. The tube is filled with water and the inclination to the vertical adjusted until the meniscus of the water at the surface of the funnel is plane at the instant that the drop falls. The value of p is then the pressure due to a column of water whose height is the difference of level between the section of the drop of radius r and the surface of the funnel. Then p being determined, the other quantities can be found in the ordinary way and the surface tension calculated. The values so found are compared with those found from the simple formula $T = (P/2\pi)(1/r + 1/R)$, where R is the radius of the sphere which has the same volume as the drop, as determined by its mass after falling. This approximate formula is found to give good results when the tube is small. The effect of the adherence of part of the drop to the tube is also investigated, the shape of the drop being determined by projecting its magnified image upon a screen. In using the approximate formula, the error introduced by neglecting the adherent part is, in the case of hemispherical drops formed on small tubes, less than 1/17 when $r/R = 0{\cdot}5$ and 1/126 when $r/R = 0{\cdot}2$. The author, therefore, recommends the use of tubes of small diam. It is also claimed that the determination of the surface tension by the first-given method, in which p is directly determined and the exact formula used, is superior to that of the capillary tube, in which the height of ascent of the liquid is measured. S. G. S.

1817. *Rotating Liquid Sphere.* **P. Thirion.** (Annal. Soc. Sci. de Bruxelles, 30. pp. 175–189, 1905–1906.)—A spherical glass vessel containing water in which solid particles are suspended, being caused to rotate, the particles collect in a complicated manner. A fairly sharp circle of particles forms in the lower hemisphere, while in the upper a cloudy appearance is produced. By carefully adjusting the conditions of experiment a definite circle may be produced in the upper hemisphere, which is nearer the equator than that in the lower, and which appears to be very unstable. From the equation for the forces on any particle it is found that the lines of force only cut the surface of the sphere at right angles in one region and that is the circle in the lower hemisphere. Hence this is the only locality at which the particles which are denser than water can remain in equilibrium. If, however, there is friction between the particles and the sphere the region of stable equilibrium is widened, and one appears in the upper hemisphere. By roughening the sphere inside, the author found it to be quite easy to produce the upper circle. [See also Abstract No. 1172 (1906).] S. G. S.

1818. *Mean Path of a Gaseous Molecule.* **M. Smoluchowski.** (Acad. Sci. Cracovie, Bull. 3. pp. 202–213, March, 1906.)—The probable motion of a single molecule under the action of successive collisions has not, the author thinks, been duly studied in connection with the zigzag shape of its path, and he calculates that, with the assumption of a constant speed c, the mean radial distance travelled after n collisions is $\lambda\surd(16n/3\pi)$, and the radial distance of mean square is $\lambda\surd(2n)$, where $exp(-x/\lambda)$ is the probability of a path x being traversed without collision. This leads to the expression $\frac{1}{3}c\lambda$ for the coefficient of diffusion. R. E. B.

1819. *Friction and Force due to Transpiration as dependent on Pressure in Gases.* **J. L. Hogg.** (Amer. Acad., Proc. 42. No. 6. pp. 115–146, July, 1906. Contribution from the Jefferson Phys. Lab., Harvard College.)—This is a preliminary paper on an investigation of (i.) the relation between the friction of a gas on a solid body, and the pressure in the gas at these low pressures where slip is appreciable; (ii.) the relation in a simple case between the transpiration-force on a perforated partition separating two portions of a given gas at different temperatures and the mean pressure in the gas; (iii.) the feasibility of measuring the pressure in the gas from either of these relations, and without recourse to a McLeod gauge. The great difficulty of devising and carrying out methods of constructing the pieces of apparatus required—so as, for instance, to remove all traces of moisture from the solid surfaces of complicated shapes exposed to the interior of the containing vessel—seem to have been satisfactorily overcome. The friction has been measured at pressures ranging from 1 atmo. to 0·00024 mm. of mercury as measured by a McLeod gauge, and Kundt and Warburg's law represents the results down to a pressure of 0·1 mm. but not beyond. The transpiration force was measured over a range of pressures varying from 1·42 mm. to 0·0093 mm., and it was found that for pressures below that for which this force is a maximum [about 0·118 mm.] the relation between the force and the pressure rapidly becomes one of mere proportionality. R. E. B.

1820. *Colloidal Nuclei in Carbon Dioxide.* **C. Barus.** (Phys. Rev. 23. pp. 31–36, July, 1906.)—Further investigations with the author's apparatus, used with dust-free air, are described [see Abstract No. 1668 (1906)]. The phenomena resemble in character those observed in the case of air, but the colloidal nuclei are apparently smaller than in air. Experiments with coal gas were also made, but in these the corona was thin and blurred. The behaviour of the hydro-carbon gas at first seemed to differ much from that of air or CO_2, but when care was taken to have the exhaustion chamber as well as the fog chamber full of dust-free coal gas the behaviour approached that of the other gases in character. J. J. S.

1821. *Time Variation of the Initial Nucleation of Wet, Dust-free Air.* **C. Barus.** (Science, 24. pp. 180–181, Aug. 10, 1906.)—In further observations on the time variations of the efficient colloidal nucleation in filtered air, the dependence of the nucleation on the fluctuations of the barometer showed itself clearly. The minima of atmospheric pressure coincide with maxima of the larger colloidal nucleation, and therefore (by inference but not necessarily) with minima of ionisation of the dust-free air, both in the daily and in the weekly periods of observations. The causes of the observed behaviour are doubtful and the interpretation of the results obscure. [See Abstracts Nos. 1542, 1668 (1906), and preceding Abstract.] J. J. S.

1822. *Formation of Cloud Spheres and Photospheres.* **A. W. Clayden.** (Roy. Astron. Soc., Monthly Notices, 54. pp. 58–66, Dec., 1905. Monthly Weather Rev. 34. pp. 167–170, April, 1906.)—In discussing the influence of pressure and temperature on the vaporisation of liquids, such phenomena being probably of great applicability in the formation of planetary and stellar atmospheres, the author gives examples of the conditions met with in the case of ice, water, and steam. From an examination of the resulting curves it appears that the result of suitably diminishing the mass of a planet may be to produce exactly the same effect upon any cloud sphere, by which it may be surrounded, as would be brought about by increasing the temperature, or that a hot planet of large mass might present exactly the same features as a cooler and smaller one. If this be true it will be obvious that a determination of the temperature of the outer surface of a cloud sphere would be no measure of the temperature of the solid planet beneath. It is next attempted to carry the analogy to the case of stellar photospheres, assuming that the preponderating element is carbon, and various suggestions are given on the probable evolution of stellar types from the primary mass. C. P. B.

1823. *Relations between the Velocities of Progression of Lows and the Areas of Rising and Falling Pressure accompanying them.* **S. Hanzlik.** (Monthly Weather Rev. 34. pp. 205–209, May, 1906.)—The author continues his studies [see Abstracts Nos. 9 and 955 (1905)] with the aid of the pressure-change charts of the Central Office at Washington, referring to Clement Ley, Ekholm, and Sresnewsky, whose lines of argument he has followed, and to Brounow, who first, in 1878, attempted forecasting from pressure-change charts. He examines three successive weather maps, *e.g.*, at 8 a.m., 8 p.m., and 8 a.m., and applies rectangular co-ordinates in such a way that the track of the low coincides with the X axis; the positions for the three hours of the areas of rise (in which the barometer was rising) and of the areas of falling barometer are marked on the diagrams. He also distinguishes between lows of increasing and of decreasing velocities; in the former case the velocity of motion of the low would have to be at least 200 miles greater for the second interval of 12 hours than for the first. One of the conclusions arrived at is that there is apparently no relation between the three velocities, of the lows, of the preceding areas of fall, and of the following areas of rise. He also studies the advance of the "dead lines" of zero pressure-change. H. B.

1824. *Existence of the Isothermal Zone in the Atmosphere at the Height of* 10 *to* 12 *km.* **R. Nimführ.** (Meteorolog. Zeitschr. 23. pp. 245–253, June, 1906. Nature, 74. p. 623, Oct. 18, 1906. Abstract.)—In 1902, Teisserenc de Bort and R. Assmann announced almost simultaneously that the records obtained with the aid of unmanned balloons showed the existence of a warm air stratum in the free atmosphere at a height of about 10 km. Further observations tend to confirm this assumption, which is, however, regarded with suspicion, because this isothermal zone or inversion stratum is in most cases found at the maximum height attained. Bort uses chiefly paper balloons, open below, which finally may be supposed to drift instead of continuing to rise; the draught through the Assmann aspiration tube would then stop, and radiation have full play. Assmann, therefore, introduced rubber balloons, which are very largely used; these balloons, which are closed below, rise until they burst, and should not drift. It was assumed that, starting with an initial velocity of 4 m./sec., they would attain 5 m./sec. at 12 km., and 6 m./sec. at 20 km. elevation (Hergesell); the initial velocity is generally 5 m./sec. But the velocity really diminishes somewhat, partly owing to pores, which even the best rubber shows when distended. The author, therefore, thinks that of the thousands of records available only ten cases (of Teisserenc de Bort) can be trusted, in which the sun was below the horizon during the whole time of the ascent. Examining these cases, he concludes that they do show a slow increase of the temperature gradient up to heights of 5 km., followed by a more rapid increase up to 9 km., and then by a decided diminution in the gradient which may sometimes become positive. The 10 cases concern 9 months of the year 1902 and anticyclonic conditions, and they would indicate that the warm stratum is connected with the general circulation of the atmosphere. If we assume that the air at 10 km. height drifts W. to E. with a polar component and sinks by about 8·5 mm./sec., the diminution in the gradient would be accounted for. A similar sudden diminution of the temperature gradient is observed in deep water. The author would thus accept the existence of a stratum at an elevation of 8 or 9 km. in which the temperature gradient suddenly diminishes. In a postscript he adds, however, that he had just discovered a systematic source of error in bimetallic thermometers which would make them unreliable even in the dark, and he withdraws his conclusion. H. B.

1825. *Present-day Climates in their Time Relation.* **F. M. Ball.** (Monthly Weather Rev. 34. pp. 201–205, May, 1906.)—The popular belief that the climate is changing is not supported by an examination of some of the oldest records available, Angot's dates of vintage days since the fourteenth century, and temperature averages at St. Petersburg (since 1743), Philadelphia (since 1758), and St. Paul, Minn. (since 1822). Geology, on the other hand, teaches us that the climates must have changed many times. The author discusses the general factors which determine climate, with special reference to the changes in the distribution of land and sea, changes of elevation, to Croll's theory, to T. C. Chamberlin's hypothesis that refrigeration and glacial sparks might be due to a depletion of the atmosphere of carbon dioxide, water vapour, and dust particles, and to the changes in the winds that would result from change in the configurations of the continents. H. B.

1826. *Depth of Hypocentre of Seismic Disturbances.* **G. B. Rizzo.** (Accad. Sci. Torino, Atti, 41. 15. pp. 795–800, 1905–1906.)—On determining the velocity of propagation of the disturbance along the surface of the earth radially from the epicentre, and drawing a curve with distances from epicentre as abscissæ and actual velocities as ordinates, it is found that the curve first falls rapidly, at a definite point alters its course, and thence rises steadily. This steady rise corresponds to what the author calls "normal velocity," and on producing the "normal" curve back to the axis of velocities the "normal velocity" for points in the neighbourhood of the epicentre is found. The difference between actual and normal velocities is plotted as a second curve which falls rapidly from the epicentre and becomes zero at the point of minimum actual velocity. The author thinks it reasonable to suppose that this component of the velocity is due to the proximity of the surface of the earth to the hypocentre, and that the hypocentre is in the plane of the circle which consists of the points having minimum velocity, and is situated at the centre of the circle. In this way the author finds the depth of the hypocentre in the case of the earthquake at Calabria on Sept. 8, 1905, to be 50 km. S. G. S.

1827. *Horizontal Pendulums and Earth Echoes.* **C. C. Farr, J. Milne.** (Nature, 74. pp. 515–516, Sept. 20, 1906.)—Farr criticises Milne's deduction of the tilt indicated by the seismogram of the usual pattern, and insists that it should be considered as a function of the boom period, the wave period, the log. decrements of the free vibration of the boom, and of the earth-wave. Moreover, it is probably much smaller than usually supposed. Earthquake echoes may be regarded as interference effects between the free and forced vibrations. In reply, Milne repeats his reasons for considering many secondary movements as pure reflective phenomena, and at the same time admits that very frequently terminal vibrations of an earthquake do present characteristics suggestive of interference effects. C. P. B.

1828. *Nature and Origin of Volcanic Heat.* **E. Thomson.** (Science, 24. pp. 161–166, Aug. 10, 1906.)—Any solid subjected to a pressure such as to cause it to flow in a restricted channel will, in so moving, rise in temperature until it has reached a degree of fluidity such as to stop the absorption of energy in moving the mass, or until it escapes from the passage. Such pressures are caused by flexures taking place in the earth's crust. Melted lava may play a part in volcanic phenomena without reaching the surface. This extension of Mallet's view would make the paroxysmal nature of volcanic eruptions almost a necessity. On globes like the earth and moon early outbursts would be without violence, and the materials ejected would have temperatures not greatly above those of the surrounding masses. As the globes become cooler and more rigid, the mechanical energy spent in causing an eruption would lead to higher temperatures and more violent eruptions. The appearance of the lunar volcanoes support this view. From the enormous deep craters like Tycho Brahe and Copernicus streaks of deposited matter extend for hundreds of miles in almost radial lines, as if vapours had been escaping into a vacuum or a rarefied atmosphere. These are the craters of the more recent, violent eruptions. The shallow craters like Archimedes and Plato, on the other hand, show streaks, and the fused matter seems to have gently been welling up from great depths in ancient times. **T. J. J. See.** (Ibid. pp. 301–308, Sept. 7, 1906.)—See accepts neither Mallet's hypothesis nor E. Thomson's modification of it. The high rigidity of the earth does not really disprove internal fluidity; the pressure on the fluid interior would be so great as to render tidal surgings and Fisher's currents impossible. One common cause underlies earthquakes, volcanoes, the formation of mountains and islands and of great sea-waves, and the feeble attraction of mountains noticed in geodetic operations. The author criticises R. J. Strutt's views on radium as a source of the internal heat of the earth, and refers to his own articles [see Abstracts Nos. 961, 1855 (1905) and 1830 (1906)]. **C. Barus.** (Ibid. pp. 400–403, Sept. 28, 1906.)—Making a rough calculation on E. Thomson's assumption, Barus concludes that a shear stress sufficient to melt rock might be found at a depth of 190 miles, too low down for vulcanism. He recalls an observation of his of 1891, that liquid water (not steam) will dissolve glass at a temperature below 200° C. to a solid resembling igneous glass; the reaction takes place under a contraction of 20 or 30 per cent., but he could not observe that this enormous contraction was accompanied by an evolution of heat. Water from the ocean, meeting the 200° C. isothermal at about 5 miles below the surface, would cause fusion of the rock; this vulcanism would cease after a while and might be periodic. Mechanical pressure would not force water into a hot stratum as E. Thomson objected; but osmotic pressure and capillarity were concerned. Barus also criticises C. E. Dutton's views on volcanoes and radio-activity. **L. M. Hoskins.** (Ibid. p. 403, Sept. 28, 1906.)—Hoskins criticises See's proposition that the earth should be at the same time fluid and highly rigid; this implied a misunderstanding of Kelvin's definition of the modulus of rigidity. H. B.

1829. *The Chilian Earthquake of Aug.* 16, 1906. **A. Obrecht.** (Comptes Rendus, 143. pp. 525–526, Oct. 8, 1906.)—The earthquake began at Santiago at 7 h. 58 min. 50 sec. local time. The first series of undulations lasted for 4 min. 50 sec.; after a pause of 4 min. the undulations set in again, but only for 20 sec. The amplitude of the horizontal oscillations was about 0·1 m., their period 0·5 sec. The seismograph of the observatory at Santiago was found broken by the author a few min. after the earthquake; the curves (not reproduced) represent only the first phase of the phenomenon, and indicate that the shocks were directed E.-W. H. B.

1830. *Physical Constitution of the Heavenly Bodies.* **T. J. J. See.** (Astronom. Nachr. 169. pp. 321–364, 1905.)—After dealing with the general principles upon which the physics of the heavenly bodies may be based, the author puts forward a monatomic gaseous hypothesis as to the constitution of the sun and the major planets; and on this theory the details of their physical nature, as well as of that of the stars, are examined and mathematically treated. The paper is too lengthy for adequate abstraction and should be referred to for the numerous conclusions, some of the most noteworthy of which are as follows: The mean specific heat of the sun must lie between 0·5 and 6·8; it could reach the latter value if all the elements present were as simple as hydrogen. The heat and light from the sun, are held to be obtained from the interior solely by radiation, and not by convection currents; the gases in the interior are very transparent, but on the photosphere some elements, such as carbon, can give rise to clouds which are non-transparent to light. Based chiefly upon the density at the solar surface, the heat supply of the sun is held to be sufficient to last 10 million years at the present rate; or taking contraction into consideration, 30 million years. As regards the earth before it had a solid crust, the temperature probably was never sufficiently high for it to be self-luminous. On the major planets the surface temperatures are considered to lie between 300° and 800° abs., so that the surface can neither be thought of as rigid nor self-luminous; these planets are not cooling down at present, but are even becoming hotter. The author considers the monatomic theory, as applied to the sun's condition, to be the only one which permits of mathematical treatment and yet gives results which are in accord with known facts. L. H. W.

1831. *Chromospheric and Coronal Spectra.* **F. W. Dyson.** (Roy. Soc., Phil. Trans. 206. pp. 403–452, Aug. 23, 1906. Roy. Soc., Proc. Ser. A. 78.

p. 240, Sept. 6, 1906. Abstract.)—Tables of wave-lengths of lines determined from spectra obtained during the total solar eclipses of 1900, 1901, and 1905. Dealing with the identification of the lines it was found that arc-line comparisons were quite useless, and the majority of the stronger lines of the chromospheric spectrum were found to be strong spark lines of Ti, Cr, Sc, Y, Fe, Mn, and Zr. In the hydrogen series of rhythmic lines, 26 members have been measured from δ (4101·92) to ϵ' (3661·39), and by comparison of the observed wave-lengths with those computed from Balmer's law it appears that the formula is correct to within 0·01 of a tenth-metre. *Helium.*—The helium lines are strongly shown, but those of parhelium are doubtful. *Argon, xenon, neon,* and *krypton* are apparently absent. *Carbon* is represented by a number of lines including the heads of the band at 3883. *Sodium.*—The lines D_1 and D_2 can be faintly seen on one photograph, and the lines at 3303 are probably shown. *Magnesium.*—The *b* lines and the first violet triplet are well shown, but the ultra-violet triplet is not shown. The strongly enhanced line at 4481·3 may possibly be represented by a line of intensity 1, but the latter line measured can be satisfactorily identified with a titanium line. *Aluminium.*—This element is represented by both arc and spark lines. *Silicon.*—There is considerable evidence that several of the stronger spark lines of Si are present. *Calcium* is well represented as regards its spark lines, but the arc lines are extremely faint. *Scandium.*—This element is very strong in the chromospheric spectrum, the intensities of which chiefly agree with those given under spark conditions. All these lines are present in the solar spectrum. *Titanium.*—Also very strongly represented, the more intense lines being *enhanced* lines. *Vanadium.*—Not very strong in chromosphere, so far as the arc lines are concerned, but there is reason to believe that some of the enhanced lines are present. *Chromium* and *iron* are very well shown, the chief lines being the enhanced lines, showing that the conditions approach the spark temperature. *Manganese* is present, but weak. *Nickel* and *cobalt* are very weak. Several other elements are also found, including Zn, Sr, Y, Zr, Ba, La, Ce. The spectrum of the corona is represented by 24 lines; of their origins we are yet in doubt. From the experience gained in these three eclipses it is thought that a slit spectroscope is most advantageously employed when adjusted to be as nearly as possible tangential to the sun at the point of second contact, both for the chromospheric and coronal spectrum. Accompanying the paper is a plate showing the spectrum of the corona and higher chromosphere as photographed at Sfax, Aug. 30, 1905.

C. P. B.

REFERENCES.

1832. *Harmonic Analysis.* **K. H. Haga.** (Elektrotechnik u. Maschinenbau, 24. pp. 762–763, Sept. 23, 1906.)—The author explains a method of harmonic analysis which he has found useful, and which consists essentially in splitting up the Fourier series into four groups of terms, corresponding to the even sine, even cosine, odd sine and odd cosine terms. The analysis may be effected either arithmetically or graphically. A. H.

1833. *Comparative Advantages of Hard and Soft Steels for Reinforcing Concrete.* **D. B. Luten.** (Eng. News, 56. pp. 62–64, July 19, 1906.)—A discussion of the relative merits of soft and harder steels for reinforcement. As the load has exceeded safe limits before the elastic limit of the steel, even if mild, is reached, it is not possible to take advantage of the higher elastic limit of harder steel. There is very little difference between the elastic moduli of soft and harder steels. Thus the question becomes one mainly of convenience and cost. F. R.

1834. *Uniformity of Notation.* (Ind. Élect. 15. pp. 397–399, Sept. 10, 1906.)—An article in which the writer urges the desirability of an international system of symbols for physical quantities and units of measurement, and suggests a few simple rules for the formation of such a system. A. H.

1835. *Photographic Determination of Azimuth.* **A. Klingatsch.** (Akad. Wiss. Wien, Sitz. Ber. 115. 2a. pp. 101–124, Feb., 1906.)—The author discusses the errors of measures of geographic co-ordinates on photographs. The results of the mathematical investigation are expressed in three lengthy formulæ, and the total error in azimuth is obtained from these by addition. The formulæ are considerably simplified by introduction of the conditions that the picture plane shall be vertical and optical axis horizontal. A description of a photo-theodolite is appended, together with an account of experiments performed with a view to testing the application of the author's methods. A. E.

1836. *Stresses in Ships.* **J. Smith.** (Engineering, 82. pp. 436–439, Sept. 28, 1906. Paper read before the British Assoc. at York.)—An application of the stream-line apparatus to determine the principal stresses.

1837. *National Physical Laboratory. Report for the year* 1905 (pp. 3–57, 1906). (Abstracts in Engineering, 82. pp. 38–43, July 13, 1906. Page's Weekly, 8. pp. 700–702, March 30, 1906. Electrician, 56. pp. 970–971, March 30, 1906.)

1838. *Progressive Waves in Deep Water.* **R. F. Gwyther.** (Manchester Lit. and Phil. Soc., Mem. 50. 8. pp. 1–28, Aug. 27, 1906.)—A mathematical consideration of the range of such waves when the amplitude is finite. The object of the investigation is to confirm the hypothesis that this class of wave is mathematically capable of propagation with uniform velocity and without change of form, and to determine the limit of the range of such waves in height, and, as far as possible, the change in shape of the profile of the wave as the ratio of the height to the wave-length is increased. The treatment depends on an analysis of the paths of the fluid particles. J. W. P.

1839. *Diurnal Variation of Wind Velocity on Days of Full and of New Moon.* **H. Arctowski.** (Bull. Acad. Roy. Belg. Nos. 9–10. pp. 455–461, 1905.)—The author having found that the maximum wind velocity at the Eiffel Tower appears to depend upon the age of the moon, and also having noticed a certain relation between the wind velocity and the age of the moon at Uccle, gives the results of a series of observations which seem to support this view. L. H. W.

1840. *Third Scientific Cruise of the "Otaria."* **Teisserenc de Bort.** (Comptes Rendus, 143. p. 447, Sept. 24, 1906.)—The *Otaria* has returned from a cruise of 3½ months, arranged in conjunction with L. Rotch, in the Atlantic down to Ascension Island. Balloons and kites prove that the counter-trades extend up to lat. 30° N., changing into a westerly wind further north. In the equatorial regions temperatures as low as the winter temperatures of our higher strata were observed at elevations above 12 km. H. B.

1841. *Bright Meteor.* **E. E. Davis.** (Science, 24. pp. 150–151, Aug. 3, 1906.)—At 5.30 p.m. on Oct. 13, 1905, while on a Lehigh train on the way from Cortland to Elmira, N.Y., E. E. Davis observed a very bright meteor to the S. or S.W. Its first appearance was about 30° from the zenith, whence it descended rapidly in an arc to about the same distance from the horizon, where it burst like a rocket. It left a narrow, smoky trail, which gradually increased in size and changed in form to a zigzag, becoming more cloudlike in appearance and growing fainter and fainter until it was entirely dissipated. **C. Abbe.** (Ibid. pp. 340–341, Sept. 14, 1906.) C. P. B.

LIGHT.

1842. *Sensitometer for Three-colour Work.* **W. de W. Abney.** (Photographic Journ. 46. pp. 298–299, Aug., 1906.)—A sensitometer should be employed which is independent of artificial light, for the reason that such a light is deficient in blue rays. It should be set up before the camera and be illuminated by daylight, an exposure being made as in ordinary circumstances except that a screen would be placed in front of the plate or lens during exposure. The colour of any pigment can be decomposed into one, two, or three of the components of white light, white light containing certain percentage luminosities of red, blue, and green found in the spectrum at the red and blue lines of lithium and the green line of magnesium. It has been shown [Abstract No. 72 (1906)] that all pigment colours may be referred to one colour of the spectrum to which a certain percentage of white light has been added, and as the composition of the spectrum is known in terms of the three standard colours, the colour of a pigment may be translated into a definite mixture of these three. As an example, the case of a white and a red is taken; the white contains 68 per cent. of red, and the red 90 per cent. of red, the luminosity of the white being ten times that of the red. The ratio of the luminosities of the two reds in question is therefore 68/9 or 7·55/1. To make the two equal, a black disc is taken with a red central circular area. A section of the outer rim equal to 1/7·55 of the circle is made white. Such a disc, when rotated round its centre, would show the same amount of red in the red circle and the white rim, and to obtain a red screen it would be necessary to find some coloured transparent material through which such a red and white would give a negative making the red and white of the same density. The procedure is similar for other colour mixtures.

G. E. A.

1843. *Modifications of the Double-field Telescope and the Gnomon.* **G. Guglielmo.** (Accad. Lincei, Atti, 15. pp. 168–171, Aug. 5, 1906.)—The arrangement for determining the time of transit of a star previously described [see Abstracts Nos. 665 and 666 (1905)], in which two faces of a prism reflect the rays from a star into the telescope, one directly and the other having previously been reflected at an artificial horizon of mercury, suffers from the defect that any accident such as a cloud passing or a puff of wind ruffling the surface of the mercury, causes great delay as the observation can only be taken at one altitude of the star. A modification of the arrangement is now described in which the faces of a triangular prism are used; if the prism has the angles all differing, then by rotating it so as to bring each angle in turn to face the objective of the telescope three observations may be made at three different altitudes of the star. In addition three more observations may be made, in which the rays are totally reflected inside the prism, the altitude not being in this case the angle of the prism, but a simple function of it. Thus there are six possible pairs of observations which can be made, according to the position of the prism, a pair consisting of the observation before and after transit. The most convenient arrangement as regards the angles of the prism and the mounting is described. In the second part of the paper a further account of the gnomon is given [see Abstract No. 518 (1905).] For best illumination and definition combined an aperture of annular form is found to be superior to a circular one, the relation between dimension of aperture and distance of screen for best definition being $r-r'=\sqrt{D}$, where r and r' are in mm. and D is in metres. The diffraction effects produced and the appearance of the solar image at various distances are described. S. G. S.

1844. *Projection-spectroscope and Colour-mixing Apparatus.* **F. J. Cheshire.** (British Optical Journ. 5. pp. 288–292, Aug. 16, 1906.)—The various parts of the apparatus are carried on standards, adapted to slide on a Zeiss triangular bar, in the following order: Slit, collimating lens, direct-vision compound prism of glass and cinnamic ether, collecting lens, spectrum gate. The slit is made from two pieces of printer's brass rule adapted to slide in grooves, the whole slit being movable laterally. A simple reading glass with a focus of 27 cm. serves as collecting lens. The spectrum gate is a rectangular opening in a metal plate admitting of lateral adjustment like the slit. When the rays of an electric arc are focussed on the slit, a spectrum image of the slit is formed at the gate, and an image of the prism face, which may be stopped down to a circular aperture, is thrown on a screen beyond. Small skew prisms (cut from an ordinary weak prism at 30° to its edge) are placed vertically in the spectrum gate, to intercept certain colours, and cause the corresponding coloured discs on the screen to be displaced both vertically and horizontally. By suitably manipulating these skew prisms any number of complementary colours can be projected and made to overlap at will. A. E.

1845. *Microscope for High-temperature Work.* **H. Siedentopf.** (Zeitschr. Elektrochem. 12. pp. 593–596, Aug. 10, 1906. Paper read before the Deutsch. Bunsen-Gesell., Dresden, May 21, 1906. Communication from the Optical works of C. Zeiss, Jena.)—The arrangements described are intended for use with polarised light, and consist essentially of a micro-gas burner with fine adjustment and a heat condenser placed in the position usually occupied by the illuminating condenser. The temperature of the preparation is controlled by air jets, which are regulated simultaneously with the gas-burner, and the objective is water-cooled. In this way it is possible to adapt the ordinary microscope for the study of objects at temperatures up to 700°. The principle is applicable to the study of ultramicroscopic objects. F. R.

1846. *New Auto-collimating Level with Mercury Horizon.* **Claude** and **Driencourt.** (Comptes Rendus, 143. pp. 394–397, Sept. 3, 1906.)—The instrument, which is designed for use in geodetic levelling operations, consists essentially of the following parts: (1) A doubly-reflecting prism; (2) A mercury horizon placed vertically below it; (3) A horizontal telescope pointed at the prism, the latter only obstructing the right-hand half of the telescopic field of vision, the left-hand half having a clear view of the distant staff. The two faces of the prism (which is kite-shaped) where internal reflection occurs are at 45°; the two opposite faces, where the rays enter and emerge, are at 90°, being horizontal and vertical respectively. The telescope has a plate of unsilvered glass at 45° inserted between the eye-piece and cross-wires in order to reflect the rays from an external light-source down the tube and form a shadow of the cross-wires. This shadow, after undergoing double reflection in the prism, single reflection at the mercury, and again double reflection in the prism, is seen by the observer side by side with the wires themselves, and adjustment for horizontality consists in bringing the two to coincidence. The instrument is, in fact, an adaptation, to the case of altitude 0°, of the *astrolabe à prisme* for observing equal altitudes. The authors claim for it the following advantages: (1) Accuracy as regards horizontality nearly tenfold that obtained with a bubble level; (2) Simultaneous verifying of this horizontality and reading of the staff; (3) Reversals unnecessary, a single level-taking sufficing for each staff; (4) In flat country the spacing between the staffs may be sensibly augmented. It is also added that the apparatus will be found as convenient and portable as that now in use. A. E.

1847. *Optical Analysis of Industrial Gases.* **F. Haber.** (Zeitschr. Elektrochem. 12. pp. 519–520, July 27, 1906. Paper read before the Verein Deutscher Chemiker, Nürnberg, June, 1906.)—The author describes a refraction apparatus by means of which the coefficient of refraction of a gas can be measured to within three units in the seventh decimal place. With flue gases this would correspond with an alteration of the CO_2 content by ¼ or ⅕ per cent. Methane, hydrogen, hydrogen chloride, or hydrogen cyanide in air can be determined with the same accuracy. With acetylene and hydrogen sulphide the accuracy is double, with sulphur dioxide 2½ times, and with pentane and benzene vapour about 10 times the above. T. H. P.

1848. *Measurement of Refractive Index with the Refractometer.* **C. A. Proctor.** (Phys. Rev. 23. p. 245, Sept., 1906.)—A source of error is pointed out in the method of Shedd and Fitch [see Abstract No. 1371 (1906)]. When the two paths of light in any interference apparatus are made unsymmetrical by the introduction of a lamina of a dispersive medium into one of them, the central or achromatic fringe of the white light system no longer represents zero path-difference between the interfering rays, but is determined by the condition $d\phi/d\lambda=0$, where ϕ is the phase-difference between two congruent rays and λ is the wave-length. The apparent shift is increased and the value of the index obtained is too high, the error amounting to about 1·8 per cent. in the case of crown glass. G. E. A.

1849. *Talbot's Law in Photometry.* **E. P. Hyde.** (Bureau of Standards, Bull. 2. pp. 1–32, June, 1906. See also Phys. Rev. 23. pp. 185–187, Aug., 1906. Abstract of paper read before the Amer. Phys. Soc., April 20, 1906.)—The rotating sectored disc is a valuable adjunct in photometric investigations, but its use has been limited, as many doubt the accuracy of Talbot's law. Helmholtz states this law as follows: "If any part of the retina be excited by intermittent light, recurring regularly in the same way, then, if the period be sufficiently short a continuous impression will result which is the same as that which would be produced if the total light were distributed uniformly throughout the whole period." The author has made a careful and thorough experimental investigation of the accuracy of this law. The photometer bench on which the measurements were made is a Reichsanstalt precision photometer bench, 250 cm. long, supplied with a Lummer-Brodhun contrast screen. The substitution method was exclusively employed. Direct-current Nernst glowers were used for the test source, and, as a rule, also for the comparison lamp. The glowers were burned without globes round them, and a special regulating resistance was used instead of the ordinary iron ballast resistance. The glowers had to be protected from draughts by brass tubes with a slit to let the light through. The current through the lamps could be maintained constant to within about 0·01 per cent. It was noticed that the voltage at the terminals of the glowers often changed by a few tenths of a volt. The cause of this was traced to the slight cracks which occur at the terminals of the filament. The rotating sectored disc was driven by means of a small spherical direct-current fan motor. Instead of using a disc with sectors the width of which could be varied, separate discs with different angular openings were employed. The coloured lights were produced by placing pieces of coloured glass in the eyepiece of the photometer. The tables given show that, within the range of experimental error, the deviations from Talbot's law are very minute, and are of the same order for white and coloured lights. The conclusions arrived at may be summarised as follows: (1) Talbot's law, in its application to a rotating sectored disc, is verified for white light for all total angular openings between 288° and 10°, to within a possible error of 0·3 per cent., which probably is very close to the limits of accuracy of the experiments. (2) The observed deviations from the law for red, green, and blue light are of the same order of magnitude as those for white light, and hence Talbot's law is verified for red, green, and blue light, though not to such a high accuracy as white light. Moreover, a difference in colour on the two sides of the photometer screen produces no appreciable change in the observed deviation from the law. A. R.

1850. *Comparative Light Values of the Hefner, Pentane, and Carcel Standard Lamps.* **E. Liebenthal.** (Journ. f. Gasbeleuchtung, 49. pp. 559–561, June 30, 1906. Paper read before the Verein von Wasserfachmännern.)—In view of the fact that there is as yet no common international standard lamp, the Reichsanstalt have carried out photometric measurements of the above standards, comparisons being made with a constant electric glow-lamp. The Pentane 10-c.p. lamp reaches a steady condition 10 min. after being lit. It is much more sensitive than the Hefner to air contamination. In the case of the photometer-room (of 470 m^3. capacity) being ventilated shortly before the beginning of the test, but not afterwards, the intensity of the Hefner decreased 2 per cent. in 8 hours; that of the Pentane lamp sank often by the same amount in 20 min. In spite of all precautions to ensure steadiness, there was a variation of about 1 per cent. over several hours. Three brands of pentane were used, one of which gave results 1 per cent. less than the other two; the average value obtained with the two kinds was: (Intensity of Pentane lamp)/(Intensity of Hefner lamp) = 11·0, at 760 mm., and 8·8 litres humidity (per m^3. of dry air). With a humidity of 10 litres, taken as normal for London by the National Physical Laboratory, the Pentane lamp = 10·9 Hefners. The intensity of the Carcel lamp is 10·8 Hefners, but this lamp is not so constant as the others, the variations from the average amounting to 10 per cent. The Carcel lamps, burning pure colza oil supplied to the wick by a pump driven by clockwork, were regulated 30 min. after lighting, so that the wick projected 7 mm. above the burner, and the constriction of the glass was 7 mm. above the top edge of the wick. The hourly oil consumption was then 42 to 45 gm. This lamp is also sensitive to air contamination. From previous measurements the standard candle is equivalent to 1·14 Hefners. [See also Abstract No. 1852 (1906).] G. E. A.

1851. *The Pentane Standard Lamp.* **J. S. Dow.** (Elect. Rev. 59. pp. 491–493, Sept. 28, 1906.)—The results of an experimental investigation on the possible sources of error arising from the use of the 10-c.p. Harcourt Pentane lamp as a standard are given. The most consistent results are obtained when the centre of illumination is taken as midway between the central axis and the outside of the flame. In this case the distance of the flame standard from the photometer head has little effect on the results obtained. If the more convenient, but less accurate, method of measuring from the central axis of the burner be adopted, it is necessary to make all standard measurements with the Pentane lamp at a specified distance from the photometer head. The author repeats Paterson's investigation into the effects of water vapour and barometric pressure on the illuminating power of this lamp. The formula which expresses the average results of his experiments is—

$$C.P. = 10 + 0{\cdot}071(10 - a) - 0{\cdot}0085(760 - b),$$

where a is the water vapour present in litres per m³. of pure air, b is the barometric pressure in mm., C.P. being the candle-power. This is in practical agreement with Paterson's formula—

$$C.P. = 10 + 0{\cdot}066(10 - a) - 0{\cdot}008\,(760 - b).$$

Of the 50 observations taken 28 fell within 0·5 per cent. of the calculated values, while none fell outside 2 per cent. The results obtained are compared with Liebenthal's experiments on 1-c.p. Harcourt standards and Hefner lamps [Elektrotechn. Zeitschr. p. 657, 1895; *not* those dealt with in preceding Abstract]. It appears that the change in c.p. of the 10-c.p. standard for a given change in barometric pressure is nearly twice as great as for the old 1-c.p. Pentane standard, and about eight times as great as for the Hefner lamp. It is interesting to notice that a change of 40 mm. in the barometric pressure only affects by less than 0·5 per cent. the light given out by the Hefner standard. No explanation is offered why amyl acetate and pentane flames should be influenced so differently by barometric pressure. It is pointed out that, owing to the different effects of the humidity of the air and the barometric pressure on flame standards, it is conceivable that a flame standard might ultimately be designed which would be practically independent of these two causes of uncertainty. The 10-c.p. standard, however, in this respect compares unfavourably with the older standards. **C. C. Paterson.** (Ibid. p. 569, Oct. 12, 1906.)—Paterson points out that the lamp should be used in the same way as electric standards, namely, by calibrating a comparison lamp against it. The lamp should be lit for half an hour and the ventilation of the photometer-room closed for 10 min. before the test. When these precautions are taken and the author's corrections for humidity and barometric pressure applied the results obtained are quite consistent. He does not consider that the falling off in the light noticed by Dow is due to a deficiency of oxygen. He suggests that it may be due to the excess of inert gas which has to be heated up for each volume of oxygen supplied. He criticises Dow's correction for inefficient screening and quotes mathematical results obtained by F. J. Selby. He points out that the discrepancies in Dow's results cannot be wholly due to taking a wrong centre of illumination. **J. S. Dow.** (Ibid. 59. p. 607, Oct. 19.)—In reply to Paterson, Dow explains that the fall in c.p. of the Pentane lamp in a closed room is probably due to a reduction in the available oxygen per m³. of air in the room. It cannot therefore be corrected by a formula taking into account the amount of CO_2 present in the atmosphere. A. R.

1852. *Flame Standards in Photometry.* **Laporte** and **Jouaust.** (Soc. Int. Élect., Bull. 6. pp. 375–389, Aug.-Sept.-Oct., 1906.)—A series of experiments were made on the relative illuminating powers of the Carcel, Hefner, and Vernon-Harcourt lamps. They were first compared with a glow-lamp standard. No correction for barometric pressure for the humidity of the air was applied to the Carcel lamp, but the mean of a series of 21 readings on various days was taken. The greatest difference in the readings was 4 per cent. Liebenthal's formula [of 1895, see preceding Abstract] was used to correct the readings of the Hefner lamp and Paterson's to correct the readings of the Vernon-Harcourt lamp. The following results were obtained :—

	Carcel.	Hefner.	Vernon-Harcourt.
Carcel	1	10·76	1
Hefner	0·0929	1	0·0929
Vernon-Harcourt	1	10·76	1

By direct comparison the following readings were obtained—

		Humidity.
Hefner	= 0·915 Carcel	9·1 litres per m³. of dry air.
Vernon-Harcourt	= 0·997 Carcel	10·1 " "
Hefner	= 0·095 Vernon-Harcourt	11·9 " "

The results have an inaccuracy of about 2 per cent. The experimenters had great trouble in getting consistent results and a great many measurements had to be taken. They regret that they have in practice to employ a flame standard and not a standard like that proposed by Violle. [See also Abstract No. 1850 (1906).] A. R.

1853. *Optical Constants of mechanically distorted Metals.* **S. Nakamura.** (Ann. d. Physik, 20. 4. pp. 807–832, July 20, 1906. Math.-phys. Laborat. Göttingen, May, 1906.)—An investigation into the effect produced by a mechanical stretching upon the optical properties of copper, silver, and steel. Polarised light was allowed to fall upon polished surfaces of each metal after the specimen had been stretched beyond the elastic limit so as to produce a permanent distortion. The results obtained may be briefly stated as follows: In each case the index of refraction is less when the observation was made along the direction of mechanical stress; similarly the absorption-coefficient is greater under these conditions. In the case of copper and steel under normal conditions, the value of the absorption-coefficient is greater than those obtained when the metals are stretched, while in the case of silver the reverse is found. E. C. C. B.

1854. *Abnormal Polarisation and Colour of Light scattered by small absorbing Particles.* **R. W. Wood.** (Phil. Mag. 12. pp. 147–149, Aug., 1906.)—When a beam of light was sent horizontally through an iodine cloud, a powerful red light was scattered laterally. This was polarised in a direction at right angles to that usually observed with small particles, *i.e.*, with the direction of vibration (electric vector) horizontal instead of vertical, so that the light was all but extinguished by a nicol with its long diagonal horizontal. The transmitted light is colourless, so the red light must be selectively scattered, and not produced by ordinary absorption. It can, however, be explained as due to two refractions and one internal reflection in the particle, acting like a raindrop in a rainbow. The light which is not extinguished by the horizontal nicol is colourless and polarised in the normal way for light once reflected from the particles. If the incident light is polarised the light is scattered laterally in one direction, namely, the direction of vibration of the incident light. Much difficulty was experienced in reproducing the iodine cloud; the best way was to precipitate it on a smoke cloud by heating together a particle of sealing-wax and a particle of iodine, using a very small flame. A similar effect was produced by the vapour of nitrosodimethylaniline, the normally polarised light being faint and colourless, whilst the scattered light, transmitted through a nicol with short diagonal horizontal, was yellowish-green and very bright. T. M. L.

1855. *Kerr Phenomenon.* **G. Aeckerlein.** (Phys. Zeitschr. 7. pp. 594–601, Sept. 1, 1906.)—According to Kerr the speed of light in ponderable bodies in an electric field is only influenced if the light is polarised perpendicularly to the lines of the field, *i.e.*, only when the light vector is parallel to the field lines. The matter is here tested for nitrobenzol and orthonitrotoluol. It is found that for each position of polarisation the speed is changed, the light being retarded when polarised perpendicularly to the lines of force and accelerated when polarised parallel to the lines of force. **W. Voigt.** (Ibid. pp. 811–812, Nov. 8.) E. H. B.

1856. *Scattering of Polarised Light at Matt Surfaces.* **D. Chmyrow** and **N. Slatowratsky.** (Phys. Zeitschr. 7. pp. 533–535, Aug. 1, 1906.)—Following up the recent work of N. Umow [Abstract No. 2178 (1905)] the authors have investigated, for a number of matt surfaces of colouring material, the intensity, i, of the scattered light and the fraction of it, p, which still remains polarised. Thus for eosin, i increases with λ while p decreases, the product of i and p, that is, the intensity of the polarised part of the scattered light, remaining about constant. For the other materials investigated the phenomena do not follow so simple a law. E. H. B.

1857. *Spectrum Lines as Light Sources in Polariscopic Measurements.* **F. Bates.** (Bureau of Standards, Bull. 2. pp. 239–248, Aug., 1906.)—Objection is found to the use of the D lines of sodium as a light source in polariscope measurements, owing to the possible shift in the optical centre of gravity with change of intensity. It is proposed to use the green mercury line ($\lambda = 546{\cdot}1\,\mu\mu$), and the author has measured the temperature-coefficient of the rotatory power of quartz for the D lines and the green mercury line. This will render it possible to compare the observations made with the two sources by different observers. E. C. C. B.

1858. *Spectrum of a New Gas contained in the Atmosphere.* **R. Schmidt.** (Deutsch. Phys. Gesell., Verh. 8. 14. pp. 277–282, July 30, 1906.)—In the Leyden-jar and spark-gap spectra of xenon and krypton there are about 37 lines of small intensity common to both spectra, and it was suggested that these were due to a heavier gas of the same family present in the atmosphere [see Abstract No. 74 (1904)]. The author has made some investigations into the spectra of these gases and finds no definite confirmation of the above suggestion, but claims to have discovered spectroscopic evidence of the existence of a new gas whose spectrum does not include the 37 lines referred to above. E. C. C. B.

1859. *Spectrum of nearly pure Ozone.* **E. Ladenburg.** (Engineering, 82. p. 276; with Discussion, Aug. 31, 1906. Paper read before the British Assoc. at York. Chem. News, 94. pp. 137–138, Sept. 21, 1906.)—The author described the preparation, by himself and E. Lehmann, of ozone from pure oxygen on the Goldstein method, and the examination of the absorption spectrum, exhibiting also the novel pressure gauge used [see Abstracts

Nos. 682 and 1074 (1906), and Ann. d. Physik, 21.2. pp. 305–318, Nov. 8, 1906]. Five of the absorption bands were peculiar and seemed to belong to small quantities of a new body, possibly O_6, of density 1·7 or 1·8; nitrogen compounds would not be present. In the *discussion*, **H. Rubens** added that the authors had had thirty-two explosions, and **W. G. Duffield** mentioned that A. Schuster had once observed the peculiar bands. H. B.

1860. *Doppler-effect exhibited by Canal Rays in Nitrogen.* **W. Hermann.** (Phys. Zeitschr. 7. pp. 567–569, Aug. 15, 1906. Écl. Électr. 48. pp. 420–422, Sept. 15, 1906.)—An account is given of the production of spectra which exhibit the Doppler-effect of the canal rays in nitrogen, the method being similar to that for the corresponding effect in hydrogen [see Abstract No. 297 (1906)]. As was expected, the bands do not exhibit the effect, but the lines of several series were examined and well-marked Doppler-effects observed. In the case of the line 3995·8 the velocity of the ions as calculated from the Doppler-effect is 263 km./sec., while that calculated from the kathodic fall of potential (6,000 volts) and the ratio of charge to mass is 285 km./sec. S. G. S.

1861. *Width of Spectral Lines according to Doppler's Principle.* **O. Schönrock.** (Ann. d. Physik, 20. 5. pp. 995–1016, Sept. 14, 1906. Écl. Électr. 49. pp. 141–143, Oct. 27, and pp. 177–180, Nov. 3, 1906.)—The expression for the distribution of intensity in a spectral line according to Doppler's principle, as determined by Rayleigh, is given, the distribution of velocities in the gas being that found by Maxwell. The experimental method of A. A. Michelson for finding the distribution of intensity by the interferometer is then indicated, the half-width being determined in terms of the visibility of the interference effect. An expression for the half-width in terms of the temperature and mean wave-length on the kinetic theory of gases is given, and the results of experiments for a comparison of the two methods. In the cases of the less fusible metals an arc between metallic electrodes is used as source, and in the other cases the glow discharge. Tables are also given in which the temperature is calculated from the observed "half-width"; in all cases the result is within reasonable limits; in some cases the temperature is the point of volatilisation of the metal. S. G. S.

1862. *Fluorescence and Lambert's Law.* **H. Greinacher.** (Phys. Zeitschr. 7. pp. 608–609, Sept. 1, 1906.)—It is pointed out that the increased illumination when viewing a fluorescing substance obliquely, due to the consequent foreshortening of the emitting surface, described by R. W. Wood [Abstract No. 1381 (1906)] had been previously described by H. Becquerel [see Abstract No. 765 (1904)]. According to Becquerel, the emission in the case of certain uranium salts is so feeble that it can only be observed by viewing the surface obliquely. The author in his work on fluorescence produced by radiotellurium [see Abstract No. 891 (1906)] has observed a similar effect, and also the effect of internal reflection upon the light emitted by the substance and passing through a transparent plate or lens laid upon the fluorescing surface. S. G. S.

1863. *Action of Plants on a Photographic Plate in the Dark.* **W. J. Russell.** (Roy. Soc., Proc. Ser. B. 78. pp. 385–390, Oct. 24, 1906.)—The investigation of the effect on photographic plates of various woods [Abstract No. 2219 (1905)] has been extended to include the examination of leaves, seeds, roots, bulbs, &c. All vegetable substances appear to act in a similar way. Among those bodies which do not show this property are starch, cellulose, gum, sugar, pith, and pollen. The exposure required varies from a few min. to 18 hours or more; the body must be tolerably dry. Reproductions of 16 plates are given. No reference is made to the work of Tarchanoff and Moldenhauer [see next Abstract]. L. H. W.

1864. *Natural and Induced Radio-activity of Plants.* **I. Tarchanoff** and **T. Moldenhauer.** (Acad. Sci. Cracovie, Bull. 9. pp. 728–734, Nov., 1905.)—The action on the photographic plate of certain grains which had not been exposed to any radio-active material or source is shown by several reproductions of such plates. The natural radio-activity is very small in the whole grain, but on removing the outer shell and approaching the transparent pellicules contained inside it an electroscope was promptly discharged. The induced activity was also examined. [See also Abstract No. 856 (1905).] L. H. W.

1865. *Distribution of the Intensity of the Radiation from Radio-active Sources.* **E. Rutherford.** (Phil. Mag. 12. pp. 152–158, Aug., 1906. Paper read before the Amer. Physical Soc., April 21, 1906.)—A pin-hole image of a radio-active sphere shows the greatest intensity round the edge of the image, in contrast with that of a luminous body such as the sun or a white-hot sphere which gives a uniform image. It is suggested that in the latter case the distribution of the radiation in accordance with Lambert's cosine law is due to the fact that the light does not come entirely from the surface but from a sensible depth of an absorbing layer. In the radio-active case, however, the radiations come from an extremely thin film of radio-active matter in which the α-rays are not appreciably absorbed. There is therefore no cosine law of distribution, but on the average the α-radiation from any point is equally intense in all directions. T. M. L.

1866. *Radio-active Matter in the Earth and in the Atmosphere.* **A. S. Eve.** (Phil. Mag. 12. pp. 189–200, Sept., 1906.)—The number of ions produced in 1 c.cm. of air by the γ-rays at a distance of 1 cm. from 1 gm. of radium bromide, is determined by finding the saturation current in a metallic vessel having thin walls placed at a known distance from a known mass of radium bromide, a thick lead screen being interposed between the two. The absorption produced by the screen and the air is allowed for, and since in the case of aluminium the secondary radiation is small the results for an aluminium vessel are used. The value found is $8{\cdot}1 \times 10^9$, and with a copper or zinc vessel $8{\cdot}6 \times 10^9$. It is then calculated that the whole number of ions produced in air per sec. by the γ-rays from 1 gm. of radium bromide when the rays are absorbed entirely by the air is about $8{\cdot}9 \times 10^{14}$. This is about 1/70 of the corresponding number for the α-rays. Combining this with a previous determination [see Abstract No. 1738 (1905)] of the amount of radium necessary to produce the actual amount of emanation in the atmosphere, determined by H. L. Cooke, it is deduced that the emanation present is too small in amount to produce the observed ionisation, which is consequently due to the γ-rays. The amount of radium bromide in the earth's crust which would produce the penetrating radiation is about $1{\cdot}8 \times 10^{-11}$ gm. per c.cm., and this is about four times the amount found by R. J. Strutt by observation of rock specimens. [See Abstract No. 1235 (1906).] S. G. S.

1867. *Radio-activity of the Springs of S. Giuliano.* **A. Battelli, A. Occhialini,** and **S. Chella.** (Accad. Lincei, Atti, 15. pp. 262–271, Sept. 2, 1906.)—The radio-activity of the gases liberated from solution from the waters of the springs at S. Giuliano is found to be very great, while that of the water itself is about of the order of that due to the dissolved gas, and may be due to the presence of this gas. The radio-activity is not due to the emanation of thorium or actinium, since it is not appreciably reduced by standing for 80 min. Careful determinations are then made with the object of comparing the radio-activity of the gas with that due to the emanation of radium. The rate of decay of radio-activity is found to follow the law $I = I_0 e^{-\lambda t}$ very closely, the value of $1/\lambda$ being 8 days 15 hours, while that for the emanation of radium is 5 days 18 hours. The induced radio-activity is then investigated; its rate of decay likewise follows the exponential law, and in this case $1/\lambda = 54$ min., while in the case of radium the corresponding value is 41 min. The authors then separate the emanation by compression to 100 atmos. and cooling, to remove the bulk of the CO_2 and water, the remainder being removed by caustic soda and concentrated sulphuric acid. By cooling in liquid air the emanation is removed and its effect in causing luminescence in sidot blend is exhibited; on allowing the temperature to rise the emanation diffuses away rapidly and the luminescence disappears. The spectroscopic examination and investigation of the other physical properties of the emanation are to be made and the results communicated in a future paper. S. G. S.

1868. *Disintegration Products of Radium in the Atmosphere.* **H. Mache** and **T. Rimmer.** (Phys. Zeitschr. 7. pp. 617–620, Sept. 15, 1906. II. Phys. Inst. d. Univ., Wien, July, 1906. Écl. Électr. 49. pp. 59–61, Oct. 13, 1906.)—The amount of radium emanation present in a cellar, experimentally determined, is found to be closely related to the height of the barometer; the greater the former the lower the latter. The amount of ionisation present did not follow corresponding variations. The authors also trace a connection between the penetrating radiation of Wood and Campbell and the γ-rays from the radium emanation escaping from the surface of the earth.

S. G. S.

1869. *Origin of β-Rays from Thorium and Actinium.* **M. Levin.** (Phil. Mag. 12. pp. 177–188, Sept., 1906. Phys. Zeitschr. 7. pp. 513–519, Aug. 1, 1906.)—It is not known with certainty whether thorium, radiothorium, or thorium-X emit β- as well as α-rays. Actinium also presents similar questions for solution. ThX is first separated from Th with ammonia, and then from the active deposit by heating to a high temperature. The α- and β-ray activities are then separately found. They present curves very similar in shape; but the α-ray activity is initially 60 per cent. of its maximum, while the β-ray is only about 3 per cent. These initial α-rays come from ThX and the emanation, for on account of its rapid change the latter reaches its equilibrium value in a few minutes. When equilibrium is attained there are four α-ray sources, viz., ThX, emanation, ThB, ThC; if each of these supplies an equal proportion of the equilibrium activity, then the first two should supply 50 per cent. of the total. While the activity is rising to a maximum, the ThX decreases, and hence the maximum activity is less than would have been obtained if the active deposit had initially been in equilibrium with the ThX. This theoretical value is calculated, and it is found that the activity of ThX and the emanation are together 48 per cent. of this theoretical maximum. By similar reasoning, if ThX emits β-rays, the initial activity should be 50 per cent; as it is only 3 per cent. it is inferred that the substance emits no β-rays. The time for the activity of ThX to fall to half value is found 3·66 days, less than Rutherford and Soddy's value, but agreeing with v. Lerch's number. In a similar way the initial β-ray activity of Th containing radiothorium, but free from the later products, is found to be about 8 per cent., whence again it is concluded that neither emits β-rays. Similar experiments are performed with AcX, the conclusions being that AcX is analogous to ThX in emitting α-rays but no β-rays. Godlewski concluded that β-rays were emitted, but these most probably arose from later products of the disintegration. Further investigations show that actinium itself emits no β-rays, but the initial α-ray activity cannot be reduced to less than about 28 per cent. of its maximum value. This is shown to be due to Hahn's radio-actinium. This product is separated from actinium by filtering immediately after precipitation with ammonia. When the solution so treated stands for some time it becomes turbid, and, after boiling, the precipitate consists of the actinium itself. Rutherford's conclusion that β-rays appear only in the rapid transformations of the radio-elements seems to be established.

R. S. W.

1870. *Radiation of Polonium.* **B. Kučera** and **B. Mašek.** (Phys. Zeitschr. 7. pp. 630–640, Sept. 15, and pp. 650–654, Oct. 1, 1906. Extract of paper read before the böhm. Kaiser Franz-Joseph-Akad. d. Wiss. in Prag, June 8, 1906.)—In continuation of their previous work [Abstract No. 1236 (1906)] the authors determine the absorption of polonium ("radiotellurium") rays in their metallic films. The absorption of the α-rays from polonium in metals and gases is indicated by the reduction of the ionisation curve to a lower level, as in the case of the α-rays from radium and its products. The atomic absorption or stopping power is approximately proportional to the square root of the atomic weight and has nearly the same value as in radium C. In a given gas the ranges corresponding to the same velocities of α-rays are proportional to the densities. Indifferent gases, such as air, oxygen, and CO_2, the ranges corresponding to the same α-ray velocities are exactly inversely proportional to the mean square root of the atomic weights. An important result is that the absorption of the α-rays changes with their speed, and is probably proportional to it. The atomic absorption increases with increasing speed, instead of decreasing as alleged. The dependence of atomic absorption upon the mean square root of the atomic weight is the same in metals and gases, and is not affected by the state of aggregation. The authors further attempted to confirm the existence of a secondary radiation produced by the impact of α-rays upon a metallic surface or by their passage through it. The lateral opening of an electroscope was covered with wire gauze and a vertical plate covered with polonium was placed in front of the gauze at such an angle that no α-rays could penetrate directly into the electroscope. Then a vertical lead plate was placed 1·5 cm. from the preparation in such a manner that the secondary radiation and reflected α-rays would penetrate without difficulty into the electroscope, after traversing 1 to 3 cm. of air. Any secondary or reflected radiation amounting to 0·05 per cent. of the original radiation would have been indicated, but the electroscope showed no effect whatever. The effect actually produced upon the α-rays by a metallic screen is a diffusion, like that of light in a fog. The scattering effect of metals increases with their atomic weight, probably in proportion to the square root of it. If there is an expulsion of electrons by the plate, these must be of the slow kind first discovered by J. J. Thomson and Rutherford.

E. E. F.

1871. *Mass and Velocity of a-particles from Radium and Actinium.* **E. Rutherford.** (Phil. Mag. 12. pp. 348–371, Oct., 1906.)—A preliminary account of this paper has already appeared [Abstract No. 716 (1906)]. The particles, which in every case form a homogeneous beam, traverse the space between two plates 4 cm. long and 0·21 mm. apart which are connected to a battery. They then fall on a photographic plate 4 cm. further away. The plates thus serve as a slit and as a means of producing an intense field with a comparatively small battery. The vessel containing this apparatus is highly evacuated, by Dewar's method if necessary. The theory is given for two cases: (1) When the deflection in the electrostatic field is not so great as *d*, the distance between the plates; (2) where the field is strong enough to deflect the particles more than *d*. The deflections obtained range from 0·8 mm. to several mm., and are used to calculate the value of mu^2/e. The magnetic deflection gives mu/e, hence e/m and u are determined. The former of these two qualities is the same for RaA, RaC, RaF, and AcB; but u, the velocity of projection, is different for each substance. e/m is $5·1 \times 10^3$ in electromagnetic units, with a probable error of less than 2 per cent. The values of u are RaA $= 1·22 \times 10^9$, RaC $= 1·57 \times 10^9$, RaF $= 1·78 \times 10^9$, AcB $= 1·21 \times 10^9$, all in cm. per sec. Taking the substances in the same order, the sources used to obtain a homogeneous beam are for (1) a wire exposed to emanation as negative electrode for 2 min., and then placed in the apparatus for 6 min. Twenty such wires are used in one experiment. For RaC a wire which has been exposed as negative electrode to the emanation for a longer time; 15 min. after removal the *a*-rays come from RaC only. For RaF the source is a bismuth rod coated with radiotellurium. In the case of AcB the plate is kept active by being exposed *in situ* to the emanation; the radiations from the emanation cannot be detected close to the mica screen which encloses the active substance. The photographs reproduced show two very fine and easily measurable lines. The particles are sent through mica of different thicknesses in the case of RaC; within the limits of experimental error e/m is found unchanged. The value of e/m is half that of the H atom in electrolysis, or if the charge is the same the mass of the *a*-particle is twice that of the H atom. The particle may therefore be (1) a molecule of H carrying the ionic charge; but the high speed renders it probable that such a molecule would be shattered; (2) a helium atom carrying twice the ionic charge; (3) one half of the He atom carrying a single ionic charge. The second hypothesis is taken as the most probable; and then the number of *a*-particles expelled per sec. from 1 gm. of Ra at its minimum activity becomes $3·1 \times 10^{10}$ [see Abstract No. 1589 (1905)]. The last two hypotheses lead to the same rate of production of He by Ra. The author shows how a minimum estimate of the age of radio-active minerals can be formed from their helium content; the method gives 400 million years for fergusonite. Bragg has shown that the ionisation produced by the *a*-particle at a distance r cm. from the end of its path is proportional to $\sqrt{r+c}$, where $c = 1·33$. The author has shown that the velocity r cm. from the end of its range is given by $\sqrt{r+1·25}$. From the close agreement of the two expressions it is concluded that the ionisation per cm. is inversely proportional to the velocity. R. S. W.

1872. *Mass of the a-particles from Thorium.* **E. Rutherford** and **O. Hahn.** (Phil. Mag. 12. pp. 371–378, Oct., 1906.)—This is a continuation of the work described in the previous paper [see preceding Abstract], and has been rendered possible by the use of the highly emanating radiothorium of

Hahn. The magnetic and electrostatic deflections of the α-rays from ThC are measured and the velocity $u = 1{\cdot}98 \times 10^9$ cm. per sec. and $e/m = 5{\cdot}6 \times 10^3$ deduced. The authors, considering the difficulties of the experiment, think that this proves the mass of the α-particle to be the same for ThC as for the radium products. The measurements are comparative throughout, RaC being used as the standard substance. The relative magnetic deflections are calculated from Rutherford's formula showing that the velocity is proportional to $\sqrt{r + 1{\cdot}25}$, where r is the distance from the end of the range, putting in Hahn's values for r. These agree very well with the values found by experiment. R. S. W.

REFERENCES.

1873. *Spectrocomparator.* **J. Hartmann.** (Zeitschr Instrumentenk. 26. pp. 205–217, July, 1906.)—Description of the construction of the new spectrocomparator designed for the measurement of stellar spectrograms, chiefly for the determination of radial velocities, with examples of the results obtained by its use. C. P. B.

1874. *Theory of Oblique Pencils.* **A. Kerber.** (Zeitschr. Instrumentenk. 26. pp. 218–222, July, 1906.)—This is the third contribution relating to the analytical determination of the path of a light-pencil through lenses of given curves. [See Abstracts Nos. 89 (1905), 109 (1906).] C. P. B.

1875. *Absorption Bands of the Colouring Matters of Blood.* **L. Lewin, A. Miethe,** and **E. Stenger.** (Comptes Rendus, 142. pp. 1514–1516, June 25, and 143. pp. 115–117, July 9, 1906.)—The authors have measured the position of the absorption bands of a number of colouring matters present in and prepared from blood. They have carried out their observations photographically, and claim an accuracy to 2 $\mu\mu$. The results are tabulated in the paper. E. C. C. B.

1876. *Ultra-violet Spectrum of Ytterbium.* **W. Crookes.** (Roy. Soc., Proc. Ser. A. 78. pp. 154–156, Aug. 18, 1906. Chem. News, 94. p. 37, July 27, 1906.) E. C. C. B.

1877. *Distribution of Radium in the Earth's Crust.* **R. J. Strutt.** (Roy. Soc., Proc. Ser. A. 78. pp. 150–153, Aug. 18, 1906. Chem. News, 94. pp. 94–95, Aug. 24, 1906.)—A continuation of the author's investigation into the radium content of the earth's crust. [See Abstract No. 1235 (1906).] The present paper contains the results of the determination of the radium present in certain sedimentary rocks and in certain rock-forming minerals. It is to be noted that the average radium content of sedimentary rocks does not differ appreciably from that of igneous rocks. E. C. C. B.

1878. *Fluorescence and Phosphorescence.* **E. L. Nichols.** (Frank. Inst., Journ. 162. pp. 219–238, Sept., 1906.)—A historical account of the subject of luminescence, including fluorescence and phosphorescence, in which the subject is brought up to date. S. G. S.

HEAT.

1879. *New Method of determining Coefficient of Expansion of Liquids.* **G. Costanzo.** (Phys. Zeitschr. 7. pp. 505–507, July 15, 1906. St. Ludwigs-Gymnasium, Bologna, Jan., 1906.)—This method, termed "hydrostatic" by the author, makes use of a vessel resembling a pyknometer having a known volume and a narrow neck of known bore. This vessel is filled at 0° C. with the liquid to be investigated and weighed firstly in water and afterwards in air at two different temperatures. For details the original must be consulted.

T. H. P.

1880. *Heat Treatment of High-temperature Mercurial Thermometers.* **H. C. Dickinson.** (Bureau of Standards, Bull. 2. pp. 189–228, Aug., 1906.) —The effect of annealing a number of thermometers made of Jena 59^{III} and 16^{III} glasses are tabulated and discussed, the authors pointing out that some of their experiments cover much longer periods of time than those of earlier workers (up to 80 days at temperatures between 400° and 500° C.). The following conclusions of practical importance are arrived at, in addition to detailed results for which the reader must refer to the original: (1) Jena borosilicate 59^{III} is the best thermometric glass in use, particularly for high temperatures, but it cannot be safely used at much above 500° C. when its composition is that of the sample analysed by the authors—the composition of this sample, however, differs markedly from that given as normal by the Jena firm; (2) Jena 16^{III} glass can be used up to 450° or somewhat higher with good results, and for temperatures lower than 420° a softer glass may be used for the thermometer stem; (3) every thermometer, particularly if intended for use above 100°, should undergo a suitable system of annealing before it is used, but the annealing may be done before the thermometer is filled. Thorough annealing requires from four to ten days at about 450° according to the temperature at which the thermometer is to be used, and the annealing may well be followed by a period of slow cooling for from three to six days. The total change of the ice-point for this process of annealing will be about 30 for Jena 16^{III} glass and from 20 to 30 for Jena 59^{III} glass; (4) the ice-point of a thermometer will change with use at higher temperatures and must be determined occasionally if accurate results are required. If the thermometer has not been annealed at temperatures above 400° for 16^{III} or above 430° for 59^{III} the changes will be large if it be heated above the temperature at which it has been annealed. If changes have taken place in the ice-point reading, the fundamental interval has probably changed by about 3 per cent. of this amount and the resulting error at 500 may be as much as one-fifth of the change of the ice-point; (5) to prevent boiling of the mercury in a thermometer, the space above the mercury should be filled with some dry inert gas such as nitrogen or CO_2, having a pressure of 1 atmo. at 300°, of 4½ atmos. at 450°, and of 20 atmos. at 550° C.; (6) care must be exercised that a thermometer is not overheated, allowance being made, in judging of the max. temperature attained, for the considerable stem corrections required. The author appends suggestions as to methods of annealing thermometers, for graduating the instruments so as to read direct on the gas scale, and for making stem corrections.

W. Ros.

1881. *Electrical Resistance Thermometry.* **W. Jaeger.** (Zeitschr. Instrumentenk. 26. pp. 278–284, Sept., 1906.)—Discusses the conditions for maximum sensitiveness in resistance thermometers, with the other conditions governing the choice of length, cross-section and material of the resistance wire. The author points out that the same sensitiveness can be obtained, by the use of a suitably adjusted bridge and measuring current, with any value of the total resistance of the thermometer, but the heating effect of the current employed in making the measurements enters into the problem, since it not only raises the temperature of the thermometer slightly above that of its surroundings, but also adds heat to such a vessel as a calorimeter. The author gives formulæ for the rise of temperature produced in wires of different sizes, and formulæ from which the most suitable dimensions of a resistance thermometer for any given purpose can be calculated. W. Ros.

1882. *Planck's Theory of Radiation.* **P. Ehrenfest.** (Phys. Zeitschr. 7. pp. 528–532, Aug. 1, 1906.)—Planck applies Kirchhoff's law of radiation to a fictitious system embracing resonators with hypothetical properties, and arrives at the result that the resonators have no effect on the general composition of the radiation in the system. This conclusion is only obtained by complicated mathematical reasoning, and a comparatively simple mode of reasoning is here suggested by which the conclusion appears to be at least plausible. After all, however, there remains the question how the absolute stability pre-supposed is maintained, or, otherwise, by what means the theory prevents the concentration of the energy of the system in the *infinitely* numerous ultra-violet overtones that are generated. R. E. B.

1883. *Radiation from Gas Mantles.* **J. Swinburne.** (Engineering, 82. p. 217; Discussion, pp. 217–218, Aug. 17, 1906. Paper read before the British Assoc. at York. Electrician, 57. pp. 744–745, Aug. 24, 1906.)—Various theories were discussed in the paper, but the conclusion reached was that the radiation of a Welsbach mantle is merely a high-temperature effect. In the *discussion*, **H. Rubens** agreed with this conclusion, stating the results of measures made with a mirror spectrometer and thermo-junctions of his own type upon a Bunsen burner, this burner with a Welsbach mantle of Degea type, and this burner with a mantle of "A" type previously coated with iron oxide. He found that the luminous emissivity of the mantle is always less than 1, being about 0·85 for blue light and 0·1 for red rays; that the brightness depends also on the reflective power, which for red light increases, and for blue light decreases, as the temperature rises; that the reflective power further decreases for both red and blue light with increase in the percentage of ceria in the mantle, though this effect is complicated, since the temperature of the mantle decreases from about 1,575° C. to 1,399° if the percentage of ceria is increased from 0·8 to 5, the temperature of the flame itself being 1,800°; that with these high temperatures no luminescent or catalytic action need be assumed to account for the brightness of the mantles. In answer to questions, he further stated that all the irregular optical properties of metals are connected with their electrical conductivity which is a function of the temperature. R. E. B.

1884. *Explosives.* **A. Noble.** (Roy. Soc., Phil. Trans. 206. pp. 453–480 Oct. 13, 1906. Roy. Soc., Proc. Ser. A. 78. pp. 218–224, Sept. 6, 1906. Abstract.)—This is a continuation of a long-continued research [see Abstract, No. 783 (1906)]. The explosives now examined are Norwegian 165, Norwegian 167, and Italian ballistites. Full details are given both in text and diagrams as to the differences in behaviour of these explosives in relation to each other and to the explosives previously examined; the differences in quantity of the gaseous products of the explosions are tabulated, the resulting pressures are given and the resulting temperatures are estimated as previously. As before, the estimates of temperature deduced by the two methods are in agreement at the higher densities and pressures, but differ very widely for the lower densities, and doubtless by reason of the occurrence at the lower pressures of dissociation of CO_2 which is prevented by very high pressure. Two special points are noticeable; the extraordinary rapidity with which the gases generated part with their heat, and the fact that a low development of heat accompanies the formation of a large volume of gas while the heat developed is high if a small volume of gas be generated.

R. E. B.

1885. *Dissociation of Water Vapour.* I. **H. v. Wartenberg.** (Zeitschr. Phys. Chem. 56. pp. 513–533, Sept. 7, 1906. From the phys.-chem. Inst. d. Univ., Berlin. II. **W. Nernst** and **H. v. Wartenberg** (ibid. pp. 534–547.) —Preliminary experiments in continuation of former work [see Abstract No. 1808 (1905)] are described in the first of these papers, from which it appears that good results are obtainable at high temperatures by the use of porcelain vessels, while vessels of platinum, silver or quartz introduce unavoidable errors; and they further indicate that the reaction involved is trimolecular in the neighbourhood of 1,100° C. The second paper describes and discusses the definite determinations made, the dissociation-ratio experimentally found being 0·000078 at 1,124°, 0·000189 at 1,207°, 0·00034 at 1,288°, 0·0118 at 1,882°, 0·0177 at 1,984°. These numbers agree very well with the theoretically deduced formula—

$$\log [x^3/P(2+x)(1-x)^2] = \alpha - \beta/T + \gamma \log T - \delta T - \epsilon T^2,$$

where P is the pressure of the gaseous mixture, T its absolute temperature, x the dissociation-ratio, when $\beta = 25030$, $\gamma = 2{\cdot}38$, $\delta = 0{\cdot}000138$, $\epsilon = 0{\cdot}0000000685$. The e.m.f. of a cell with the dissociated gases is found to be $1{\cdot}246 - 0{\cdot}00085\,t$.

R. E. B.

1886. *Dissociation of CO_2.* **W. Nernst** and **H. v. Wartenberg.** (Zeitschr. Phys. Chem. 56. pp. 548–557, Sept. 7, 1906. From the phys.-chem. Inst. d. Univ., Berlin.)—This paper differs from a former one [see Abstract No. 1809 (1905)] only in the re-casting of the theoretical formula which represents the phenomenon; and it is found that the experimental results agree very well with the formula of the preceding Abstract with the values $\beta = 29600$, $\gamma = 2{\cdot}93$, $\delta = 0{\cdot}001286$, $\epsilon = -0{\cdot}000000161$. R. E. B.

1887. *Temperature of Solid CO_2 and its Mixtures with Ether and Alcohol at different Pressures.* **J. Zeleny** and **A. Zeleny.** (Phys. Rev. 23. pp. 308–314, Oct., 1906. Phys. Zeitschr. 7. pp. 716–719, Oct. 15, 1906.)—It is found that, under the same pressure, solid CO_2 and its mixtures with either absolute alcohol or ethyl ether have the same temperature provided that they are in sufficiently deep flasks to be covered by their own vapour, but that the latter mixture is the best suited for maintaining a uniform temperature since its temperature is scarcely varied at all by such accidental circumstances as a draught. A table is given of the temperatures (from —77° to —116·7° C.) corresponding to pressures of from 84 to 2 cm. of mercury: the pressure needed for the production of any required temperature within these limits is thus at once determinable. R. E. B.

1888. *Continuity of the Gaseous and Liquid States, and Deviation in a Capillary Layer from Pascal's Law.* **G. Bakker.** (Ann. d. Physik, 20. 5. pp. 981–994, Sept. 14, 1906.)—A further mathematical development of the ideas put forward previously [see Abstracts Nos. 378 (1905) and 1183 (1906)]. The conclusions arrived at are that (1) the cohesion in a capillary layer differs in different directions; (2) the difference of the pressures at a point in directions normal and parallel to the layer, which may be called the deviation from Pascal's law at the point, is proportional to the square of the cohesion normal to the layer; (3) Laplace's constant is a measure of the sum of the deviations from Pascal's law at all the points on a line drawn normal to the layer; (4) the critical temperature may be defined as that temperature above which Pascal's law holds at *all* points; (5) the simplest conceivable theory of the capillary layer requires an isothermal of the shape suggested by J. Thomson. R. E. B.

1889. *Vapour Pressure.* **H. v. Jüptner.** (Zeitschr. Phys. Chem. 55. pp. 738–752, June 26, 1906.)—The chief conclusions of this paper are the following: (1) The fact that corresponding states are in concordance only for definite groups of substances, is confirmed. (2) The statement by Happel is confirmed, that in the formula $\log \pi = f(1 - 1/\theta)$, where π and θ are critical pressure and critical temperature, f is different, not only for different substances, but also for different temperatures. (3) The value of f first decreases with rising temperature, passes through a minimum and then increases. (4) This temperature of the minimum, and also the corresponding value of f, differ for different substances. (5) The decrease in f is linear. (6) After passing the minimum point, the increase in f is represented by a circle. (7) In the case of monatomic gases the f-curves appear to coincide. **P. A. Guye.** (Ibid. 56. pp. 461–462, Aug. 17, 1906. Translation.)—Guye mentions other work, not referred to by v. Jüptner, in which similar conclusions are reached. A. F.

REFERENCES.

1890. *Kirchhoff's Law.* **L. Dunoyer.** (Annal. Chim. Phys. 9. pp. 30–37, Sept., 1906.)—A modification of Kirchhoff's demonstration of the relation between the emissive and absorptive powers of a substance is here given, and the law of dependence of the radiation at a point in an enclosure at constant temperature upon the refractive index of the medium at that point is simply deduced. R. E. B

1891. *Specific Heats in a slightly deformed Elastic Medium.* **P. Duhem.** (Comptes Rendus, 143. pp. 335–339, Aug. 13, and pp. 371–374, Aug. 27, 1906.)—Five fundamental formulæ are determined which are satisfied by the isopiestic and isometric specific heats of an elastic body when slightly but homogeneously deformed in the most general manner possible. Voigt's generalisation of Reech's formula is also deduced, together with another form of this generalisation, also given by Voigt, but here shown to be true for a particular case only. R. E. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1892. *Generation of E.M.F. by Centrifugal Force.* **E. F. Nichols.** (Electrician, 58. pp. 24–25, Oct. 19, 1906. Phys. Zeitschr. 7. pp. 640–642, Sept. 15, 1906.)—If, as is supposed, an electric current is conveyed through a wire by electrons, and these are mobile while the positive and neutral atoms are fixed, it may be expected that if a metallic plate is rapidly spun round its centre the centrifugal force will urge electrons to the outer rim, and that a definite amount of work will be required to take them back to the centre; in other words, that an e.m.f. may be generated by centrifugal force. If, on the other hand, the positive atoms take a large or an exclusive part in conduction, while the electrons are fixed, a much larger e.m.f. would be produced by rotation, owing to the larger mass of the atoms. If r is the radius of the plate and ω its angular velocity, the e.m.f. is—

$$\mathrm{V} = (m/c)(r^2\omega^2/2).$$

With $r = 10$ cm. and 100 revs. per sec., V is 10^{-8} volt for electrons and 10^{-5} volt for positive atoms. The author devised an experiment to test this, but the result was negative. It showed, at all events, that the positive atoms take no perceptible part in metallic conduction. E. E. F.

1893. *Atmospheric and Subterranean Electricity.* **A. Breydel.** (Soc. Belge Élect., Bull. 23. pp. 396–408, Sept., 1906.)—As a general rule during quiet weather, the atmosphere at a height of 100, 200, or 300 m. above the ground, is at a potential 10,000, 20,000, or 30,000 volts respectively higher than the ground. On the other hand, points below the earth's surface are at a lower potential by corresponding amounts. Many balloon explosions and explosions in mines may be traced to these p.d.'s. The author discusses the question of utilising these sources of electric energy, and describes a provisional apparatus consisting of a reversible influence machine fed by a wire extending from the bottom of a valley to the top of a hill. The energy may be stored by converting it into mechanical work. The author ascribes the renewal of the energy to differences of temperature and pressure in various strata of the atmosphere and of subterranean gases, and describes an apparatus in which a thermo-electric current may be produced by heating the bottom of a long tube containing water vapour, cooling the top, and inserting collectors at the ends, which are joined through an outside circuit.
E. E. F.

DISCHARGE AND OSCILLATIONS.

1894. *Recombination of Ions.* **R. D. Kleeman.** (Phil. Mag. 12. pp. 273–297, Oct., 1906.)—In addition to the recombination of ions usually considered in the theory of conduction in gases, which has been called general recombination, Bragg and the author have shown that some of the ions produced may be only partially separated from their parent molecules, and would thus be in a position to undergo recombination with them. This they term initial recombination, and the present paper is concerned with this. Röntgen rays are passed into a chamber and the ions collected in the usual way. In one case a potential gradient of a few volts per cm. is used; in the other saturation is produced. The experimental arrangement allows the general recombination to be calculated approximately, and shows that it is negligible; the difference, therefore, in the charges collected for the different voltages is due to initial recombination. This amounts to a few per cent. only for either primary or secondary Röntgen rays. Similar results are obtained with the β-rays from uranium and the γ-rays from radium; and they vary very little when the air to be ionised is replaced by a mixture of air and a heavy vapour. When α-rays from uranium are the ionising agent, the initial recombination is much greater; in some instances over 50 per cent. of the total ions are lost in this manner. Using an apparatus similar to that used by Bragg and Kleeman in finding the ranges of the α-rays, the initial recombination can be tested for α-rays of different velocities. The result shows that the greater the velocity of the rays the less the initial recombination. This may be due to the velocity of the ejected electrons being greater when the α-rays move faster. The fact that the secondary radiations excited by β-, γ-, and Röntgen rays are very penetrating shows that the electrons are projected with considerable velocity and thus accounts for the small initial recombination. R. S. W.

1895. *Reflection of Kathode Rays.* **S. R. Williams.** (Phys. Rev. 23. pp. 1–21, July, 1906.)—At the suggestion of E. Warburg the author carried out an investigation into the reflection of kathode rays from thin metallic films with the object of determining how far, if at all, the rays penetrate beyond the front surface, and if those which pass below the surface suffer reflection at inner layers at depths which depend on the potential so that the amount reflected remains constant for varying potentials. The method employed was a photometric one, which depends on the fact that when kathode rays fall upon a fluorescent screen the brightness of the illumination varies with the potential under which they are produced, and is also approximately proportional to the current density of the rays falling upon the screen. The current densities may be compared by observing the relative brightness of the fluorescence. The apparatus used resembled in general that used by Gehrcke, but the rays were incident normally upon the reflectors. The following is a summary of the results obtained: (1) The reflection of kathode rays does not all take place at the surface of a metal, but there is penetration and the reflection for a large part of the reflected rays. (2) From a critical potential onwards a thin metallic film of aluminium reflects less than a thick one, since a part of the rays have been lost by transmission. (3) This decrease in the amount reflected from a thin film appears first in the rays most deflected, and with increasing potential will also be found in the least deflected portion. (4) The critical potential depends on the thickness and the nature of the film. For Al this critical potential for thicknesses $0{\cdot}56\,\mu$, $1{\cdot}90\,\mu$, and $2{\cdot}44\,\mu$ is 11,000, 16,500, and 21,800 volts respectively. For a copper film of thickness $0{\cdot}66\,\mu$ the critical potential has a value greater than 27,750 volts. Qualitatively, though not quantitatively, the results show a fair agreement with Warburg's theory. J. J. S.

1896. *Mercury Vapour Lamp in a Magnetic Field.* **W. Schenkel.** (Phys. Gesell., Zürich, Mitteil. No. 9, 1906. Écl. Electr. 48. pp. 321–333, Sept. 1, 1906. Abstract in Electrician, 58. pp. 139–140, Nov. 9, 1906.)—In the mercury vapour lamp a magnetic field of several units is sufficient to set up a transversal e.m.f. of the same magnitude as the primary e.m.f. The Hall-effect is investigated for a flat-shaped lamp having eight electrodes and two thermo-junctions, the magnetic field being produced by a coil with a single layer of wire. It results that for weak fields the transversal e.m.f. is a linear function of the field, but with stronger fields the transversal e.m.f. increases more slowly with the field being almost *nil* in a field of 14 gauss. This is attributed to the great variation in the vapour density across the tube caused by heating at one side. From three series of experiments the average value of the mobility found is $1{\cdot}42 \times 10^7$ cm./sec. per volt. Under certain conditions kathode rays can be produced in the mercury vapour lamp, these rays being distinguished from kathode rays produced in other gases by their causing luminescence of the vapour itself. The production of the rays is due to the presence of mercury at the kathode. Another difference noted is that the beam of kathode rays undergoes contraction and is deviated opposite to the usual direction. This last is supposed to be due to the action of the Hall-e.m.f., combined with that of the electrostatic charges on the walls of the tube. By a third experiment the values of v and e/m were determined, viz., $v = 0{\cdot}34 \times 10^{10}$ cm./sec.; $e/m = 1{\cdot}95 \times 10^7$. G. E. A.

1897. *Measuring Sparking Voltages.* **E. A. Watson.** (Inst. Elect. Engin., Journ. 37. pp. 295–302; Discussion, pp. 303–304, Sept., 1906. Paper read before the Birmingham Section. Electrician, 57. pp. 53–54, April 27; Discussion, p. 98, May 4, 1906. Abstract. Écl. Électr. 47. pp. 302–303, May 26, 1906. Elektrotechn. Zeitschr. 27. p. 528, May 31, 1906. Elect. Rev., N.Y. 48. p. 773, May 19, 1906.)—The method adopted consists in connecting two condensers to a direct-current source, a spark-gap being arranged so that as soon as the condenser is charged to a certain voltage it sparks across the gap; the charge and discharge continue so long as the condenser is connected to the source. Observing the current (C) flowing into the condenser in micro-amps., the time (T) for 100 sparks to pass, and knowing the capacity (K) of the condensers in mfd., the direct-current p.d. at which the spark occurred is CT/100K. Two condensers are put in series, with a galvanometer or microammeter in between, and the spark-gap to be tested is connected across the outer coatings; the spark-gap being connected to a Wimshurst machine. A small auxiliary spark-gap is placed across the galvanometer, the circuit of the latter being protected by two ironless choking coils, for the purpose of causing the discharge to pass across the auxiliary gap and not through the galvanometer. A table and curves of sparking voltages in kilovolts is given for different sized ball electrodes (1·35–3·2 cm. diam.). The values are in fair agreement with those of other workers, but show in particular a falling-over of the curve, which is marked for smaller electrodes. The brush discharge always occurs first on the negative ball, with equal-sized balls. Within moderate limits the sparking voltage is determined by the size of the smaller electrode; the larger one may be varied considerably without affecting the result. L. H. W.

1898. *Disruptive Voltage of Thin Liquid Films.* Part I. **P. E. Shaw.** (Phil. Mag. 12. pp. 317–329, Oct., 1906. Communicated by the Physical Soc. Electrician, 57. pp. 978–981, Oct. 5, 1906. Ind. Élect. 15. pp. 476–478, Oct. 25, 1906.)—The disruptive voltage between metal surfaces immersed in the liquids is measured by means of the author's electric micrometer. The spark-lengths vary from 0·1–10 μ; and the liquids used are various animal, mineral, and vegetable oils, certain commercial insulating varnishes, and a homologous series (pentane, hexane, heptane, octane). A good number of liquids give a straight-line law for sparking potential and distance ; castor oil, olive oil, and paraffin give peculiar wavy curves. The insulating strength does not vary much from liquid to liquid, nor is there any simple relation between composition and strength for the homologous series, nor between power of resisting discharge and inductive capacity. The corresponding curve for air shows a horizontal portion ; no such portion is shown by the curves for the liquids here used. All the liquids have a greater strength than air for voltages greater than 800 ; for lower potentials liquids have much less strength than air. R. S. W.

1899. *Electric Resistance of Solenoids for High-frequency Currents.* **A. Battelli.** (N. Cimento, 11. pp. 285–338, May and June, 1906. Accad. Lincei, Atti, 15. pp. 255–261, Sept. 2, 1906.)—In a previous paper it has been shown theoretically that the ratio of the resistance of a solenoid to that of the same wire in a straight line varies as the fourth root of the frequency of the alternating current in the solenoid. [See Abstract No. 1430 (1906).] The ratio $R/R' = K\sqrt[4]{1/T}$ is now investigated experimentally, the effective resistances being compared calorimetrically. The solenoid and a wire of equivalent length are connected in series and a high-frequency current is produced in the two by a sparking coil and condenser. The conductor is placed in some experiments inside the bulb of a liquid thermometer, in others in the bulb of an air thermometer ; in the former case the expansion of the liquid is a measure of the heat liberated in the conductor, and in the latter the increase in pressure plays the same part. In either case the heat liberated in unit time is a measure of the effective resistance, the current being the same in both conductors. The frequency of the current is determined directly by means of a revolving mirror, the image of the spark being photographed. For various frequencies and arrangements of solenoid the above relation is found to hold good.
S. G. S.

1900. *The Electrolytic Detector.* **L. W. Austin.** (Bureau of Standards, Bull. 2. pp. 261–274, Aug., 1906.)—The author first reviews the work dealing with the action of this detector, and then describes experiments made with a view to studying the action of alternating currents of low frequency and to settling some outstanding points which are the subject of controversy. The following appear to be the more important points in the author's summary of conclusions. The detector is capable of detecting a few ten-thousandths of a volt (alternating current of low frequency), and with moderate polarisation is equally sensitive whether the fine point is anode or kathode, although the action is sometimes irregular in the latter case. For electric waves from a distance the detector is approximately equally sensitive with the point anode or kathode, but for waves from a coil in the laboratory some cause appears to annul the sensitiveness of the kathode point electrode. When the small electrode is made in the form of a loop of very fine wire and an alternating current is sent through it, the resistance of the cell is decreased, indicating that heat is one of the factors in the phenomenon. Chemical action, rectification, and electrostatic attraction across the gas film probably also have a part. L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1901. *Thermo-electricity of Silver.* **W. D. Henderson.** (Phys. Rev. 23. pp. 101–124, Aug., 1906.)—A discussion, on the basis of new experiments with cells consisting of two electrodes of the same metal dipping into a solution of one of its salts, of Nernst's formula—

$$E = (RT/Kn)[2v/(u+v)] \log (C_1/C_2),$$

where E is the e.m.f., K is 96,540 coulombs, n the valency, u, v the migration velocities, and C_1, C_2 the concentrations. The main result is that in the case of Zn, Cu, Cd, and Hg the warm electrode is the kathode, whereas in the case of Ag the cold electrode is the kathode, *i.e.*, the current proceeds in the solution towards the cold electrode. Silver in this respect acts in a manner contrary to that predicted by theory. For the osmotic pressure increases with the absolute temperature, whereas the solution pressure remains most probably the same. That being so, the osmotic pressure is comparatively high in the warmer part of the cell, and metallic ions will be deposited there. This means that the warm electrode will become the kathode, as it does in the case of the diads named. The assumption that the solution pressure increases at a greater rate than the osmotic pressure is incapable of confirmation. It would imply that the solution pressure not only increases with the temperature, but with the concentration as well. E. E. F.

1902. *Lecture Experiment in Electrolytic Thermo-electromotive Force.* **H. S. Carhart.** (Phys. Rev. 23. pp. 191–192, Aug., 1906. Abstract of paper read before the Amer. Physical Soc., June 29–July 3, 1906.)—In the Helmholtz equation for the e.m.f. of a voltaic cell, $E = H/Q + T.dE/dT$, the second term is dependent on the temperature-coefficient of the cell, this coefficient being due to the thermo-e.m.f.'s at the several junctions of dissimilar substances in the cell. In a Helmholtz concentration cell, the heat of reaction is approximately negligible, so that the e.m.f. should be represented by the second term of the above equation. Electrolytic e.m.f. may be illustrated by the following experiment. Two fine iron wires are soldered to the ends of a piece of constantan wire as a thermo-couple, the junctions being placed in thin glass tubes, into which a little mercury is poured to conduct heat. A helix of fine copper wire is wound closely round the end of each tube outside the junction of the iron and constantan. The tubes with their thermo-junctions are then immersed in a concentrated solution of copper sulphate and a current is passed through by means of the copper wires. A sufficiently sensitive galvanometer shows that a difference of temperature is soon established between the copper electrodes, the anode, at which the current encounters an opposing e.m.f., being the warmer. Heat is generated at the anode and absorbed at the kathode by the thermo-e.m.f. T. H. P.

1903. *Relation between Electric Resistance and Viscosity of Electrolytic Solutions.* **P. Massoulier.** (Comptes Rendus, 143. pp. 218–220, July 23, 1906.)—Determinations of the conductivity and internal friction of solutions of hydrogen chloride in mixtures of water and glycerine at 0° show that the resistance and viscosity increase in the same sense at all concentrations, although the two magnitudes are not exactly proportional. The same is the case with solutions of sugar in water at 25°. [See Abstract No. 1300 (1900).] T. H. P.

1904. *Absolute E.M.F. of Standard Cells.* **K. E. Guthe.** (Bureau of Standards, Bull. 2. pp. 33–70, June, 1906.)—The e.m.f. was determined by the use of an absolute electrodynamometer with coils of a single layer of wire, the electromagnetic effect of the two coils upon one another being balanced by the torsional moment of a single wire. The dimensions of the coils were chosen so that the length and radius of each are in the proportion $\sqrt{3}/1$. In addition the fixed coil was made large in comparison with the movable one so that the expression for the torque should assume a simple form. The frame of the stationary coil is of plaster-of-Paris, is 55 cm. long, 10 cm. thick in the wall, and 55 cm. in diam. The average diam. was determined by three observers and is the mean of 378 readings. The cylinder is wound with a single layer of double silk-covered wire of 0·0495 cm. diam., two separate wires being wound side by side; the total number of turns is 872, but the winding is not quite uniform as it was done entirely by hand. In order to increase the accuracy of the result two movable coils of different diameters were used; the frames of these consist of porcelain cylinders and were ground true in the instrument shop of the Bureau. In the construction of the electrodynamometer as a whole, care was taken to avoid any additional field which might produce a torsional moment upon the movable coil, and arrangements were made to ensure that the centres of the two coils should be coincident. A great deal of time was spent in an attempt to find a suspension for the movable coil which would show the smallest elastic after-effect and at the same time not change its elastic properties in course of time. The attempt has been only partially successful. The material which proved to be superior to all others tried, is a piece of phosphor-bronze wire 12 years old. The standard cells were furnished by Carhart and Hulett [see Abstracts Nos. 2276 (1904) and 576 (1906)], 8 Clark's and 9 cadmium cells being used. In addition 6 Weston cells (unsaturated) were employed; these were accompanied by Reichsanstalt certificates. The cadmium cells with electrolytic mercurous sulphate form two distinct series differing in e.m.f. by 0·00006 volt. The e.m.f. of the series with the lower e.m.f. was determined as 1·01847 volt at 20° C.; that of a cadmium cell prepared in the usual way is given as 1·01877 volt at 20° C., *i.e.*, 0·00015 volt higher than the value assigned by the Reichsanstalt. The e.m.f. of the Clark cells reduced to 15° C., using the accepted temperature-coefficient, would be 1·43300 volt; but these cells appear to have a slightly different temperature-coefficient, and assuming this the e.m.f. would be 1·43293 volt at 15° C. or 0·00013 volt higher than the Reichsanstalt value. The value assigned to the electrochemical equivalent of silver when a porous cup voltameter is used is 1·11773 mgm. per coulomb.

F. E. S.

1905. *Cadmium Standard Cell.* **G. A. Hulett.** (Amer. Electrochem. Soc., Trans. 9. pp. 239–245; Discussion, pp. 246–247, 1906. Phys. Rev. 23. pp. 166–183, Aug., 1906.)—Both legs of the cadmium cell have a decided temperature-coefficient, but the effects being oppositely directed the total coefficient is very small. A change of 0·00917 volt was found for each leg of an H cell for a change in temperature of 80° C. Recent observations indicate that the cadmium cells made 2 years ago with electrolytic mercurous sulphate have fallen in value by 0·00011 volt. On the other hand, some Clark cells set up on three different dates are in excellent agreement; this indicates that the change observed in the cadmium cells is not a peculiarity of the depolariser used. When the system in the kathode leg of a cadmium cell is stirred, the e.m.f. is variable for some considerable time after stopping the rotation. If it is stirred until no further change takes place the cell has a value higher by 0·0014 volt than the normal. It seems reasonable to conclude that there is some interaction between the cadmium sulphate solution and the mercurous sulphate, which produces an increase in the mercury concentration of the solution; but when the solids settle down on the mercury, another change takes place at the boundary between the mercury and the paste, which causes a decrease in the mercury concentration of solution next to the mercury. On rotating the kathode leg of a Clark cell no such changes are observed. The Clark cell made with recrystallised zinc sulphate and electrolytic mercurous sulphate has the value 1·43300 volt at 15·0° C. as determined by Guthe [see preceding Abstract; also Nos. 576 and 1432 (1906)]. F. E. S.

1906. *Absolute Standards of Inductance.* **J. G. Coffin.** (Bureau of Standards, Bull. 2. pp. 87–143, June, 1906.)—In the first part of this paper the construction and measurement of some standards are described. Each inductance coil consists of a single layer of wire wound on a nearly perfect circular cylinder of marble. This latter was ground on a Poole grinder as used to shape the rolls or calendars employed in paper machinery. The cylinders are remarkably perfect, the max. variation in the diam. being 0·0013 cm. On one of the standards the wire was singly wound, the winding being divided into three parts. On the other coil two strands were wound at once, the subdivisions being such that there are in reality four separate and distinct coils in pairs. This coil also furnishes a standard of mutual inductance. In the second part of the paper the theory of the calculation of standards of mutual and self-inductance is given. The first method considered is by the summation of a finite series; the second is by a converging infinite series; the third is an exact formula in terms of elliptic integrals; the fourth is a hitherto unpublished formula due to Kirchhoff; the fifth is Maxwell's formula; and the sixth is an expansion of Maxwell's formula communicated by Ròiti. The coil lengths are taken as extending from the centre of gravity of the last semicircle of wire on one end to the corresponding point in the last semicircle at the other end. This is an approximation which is thought by the author to be very near the theoretical length [see next Abstract]. The values of the self-inductance as calculated by the method of elliptic integrals and by the converging infinite series, agree to within 1 part in 50,000. F. E. S.

1907. *Self-inductance of Single-layer Coils.* **E. B. Rosa.** (Bureau of Standards, Bull. 2. pp. 161–187, Aug., 1906.)—The two formulæ employed by Coffin [see preceding Abstract] give results in very close agreement, and the only question remaining is whether the two closely-agreeing formulæ are as accurate when applied to the coil in question as they appear to be. In deriving the formulæ the current is supposed to be uniformly distributed over the surface of the cylinder, whereas the coil is actually wound with 661 turns of round wire having a diam. of 0·0634 cm. and insulated by a covering 0·0030 cm. thick. The author shows that the summation formula which takes account of the actual size and position of the wires of the coil gives the true value, and that the current-sheet formula, which is very exact for a current sheet or for a winding of thin strip, cannot be applied without modification to a winding of round wires. Coffin's correction by reducing the length of the solenoid makes the matter worse. When a series of round wires are used the magnetic field is very intense close to the wires, and the smaller the wire the stronger is the field and the greater the self-inductance. For the case of mutual inductance between two coils at a distance from each other, the size of the wires (if not too great) is immaterial. The paper is largely mathematical and deals with the corrections to be applied to coils wound with a large number of turns of fine wire. F. E. S.

1908. *Measurement of combined Resistances and Capacities.* **S. R. Milner.** (Phil. Mag. 12. pp. 297–317, Oct., 1906. Electrician, 58. pp. 60–63, Oct. 26, 1906. Abstract.)—This paper describes the use of the Ayrton and Perry secohmmeter for such measurements. Cases in point are the determination of (1) the resistance of an electrolyte between electrodes which become appreciably polarised, (2) the surface capacity of electrodes in a solution the resistance of which is not negligible, (3) the capacity of a condenser which has an appreciable leakage. Here we are dealing with the equivalent of a resistance and a capacity combined in such a way that they cannot be taken apart and measured separately. For the accurate determination of the members of such a combination by the Wheatstone bridge, each must be individually balanced by that of a similar combination in one of the other arms. Nernst has shown that with the telephone the two adjustments can be made independently, and an investigation of the theory and practice of the use of the secohmmeter shows that methods are available for adjusting to the double balance, as simple and effective as those of Nernst. These investigations are fully described. F. E. S.

1909. *Ballistic Galvanometers.* **H. A. Wilson.** (Phil. Mag. 12. pp. 269–272, Sept., 1906. Paper read before the Physical Soc., May 25, 1906. Electrician, 57. pp. 860–861, Sept. 14, 1906. Elect. Rev., N.Y. 49. pp. 633–634, Oct. 20, 1906.)—This paper gives the formulæ for several types of ballistic galvanometer. The moving-coil galvanometer with iron core and radial magnetic field is superior to all the others as regards the simplicity of the exact formula to be used with it. It is also superior in most other respects. The formula usually given for ballistic galvanometers is not generally applicable; it differs appreciably from those obtained by the author. F. E. S.

1910. "*Dead Points*" *of Galvanometer Needle for Transient Currents.* **A. Russell.** (Phil. Mag. 12. pp. 202–210, Sept., 1906. Paper read before the Physical Soc., May 11, 1906.)—The paper opens with a short *résumé* of the investigations upon transient currents, direct or oscillatory, passing in a galvanometer coil. Then follows an account of the theory, starting with the equation of motion of the needle of a fixed-coil galvanometer when the position of equilibrium makes an angle θ_0 with the position of symmetry, Rayleigh's coefficient (γ) for the term involving the variable part of the magnetisation of the needle due to the current in the coil being considered to be constant. The expression for the moment of the applied forces consists of terms involving motion and those which do not involve motion. Equating the latter to zero the expression $\mu G/\gamma = -i \sin\theta_0$ is obtained, θ_0 being the position of equilibrium, μ the magnetic moment of the needle, and G the ordinary constant of the coil. In this position the current produces no deflection, and a knowledge of it determines the ratio $\mu G/\gamma$. By integrating once the equation of motion and neglecting the energy due to eddy currents it is found that the angular velocity of the needle is zero after the passage of a transitory current when $\sin\theta_0 = -2\mu GR/\gamma V$, and there is thus no throw.

V is the p.d. to which the terminals of a condenser are charged, and R the effective resistance of the condenser—galvanometer circuit. The points at which this relation holds are called by the author "dead points." By making a series of determinations of θ_0 and R, the other quantities remaining constant, and plotting the results, a straight line is obtained which passes through the point $(-R_1, O)$. R_1 is thus the "effective internal resistance" of the condenser itself which can be found in this way. The value for a given condenser using different values of R is found to be constant. The expression for the throw under general conditions, the original position of the needle being θ_0 is then obtained and is found to be $\theta_1 - \theta_0 = \pm \theta' + \lambda\theta_0$, where θ' is the throw for the symmetrical position of equilibrium and λ a complicated quantity depending upon the charge, capacity and resistance, and the constants of the instrument. Writing the expression differently it is found that the relation between throw and resistance is a hyperbolic one; between throw and p.d., parabolic; and between throw and capacity, linear. The results obtained with a low-resistance fixed-coil galvanometer are in accordance with these conclusions. S. G. S.

1911. *Gray Absolute Electrodynamometer.* **E. B. Rosa.** (Bureau of Standards, Bull. 2. pp. 71–86, June 1906.) [See Abstract No. 1284 (1905).]—The theory of the instrument is examined with respect to sources of error arising in its construction and measurement. The torque in terms of the field H at the centre of the fixed coil is given by the formula, $T = HI_1AI_2$, where H is due to unit current and is equal to $2\pi N_1/c$. $A = \pi r^2 N_2$; N_1 and N_2 are the whole number of turns and I_1 and I_2 the currents in the fixed and movable coils respectively. c is half the diagonal of the fixed coil. This formula applies strictly to the case of a current sheet on each of the two cylindrical coils, and it is necessary to inquire whether a winding of insulated wire is exactly equivalent to the current sheet. In the general case the author states that this is so to within less than 1 in a million, the length of the equivalent current sheet being, in a winding of insulated wire, the overall length of the winding, including the insulation on the first and last wires. This is equal to the axial length of the central filaments of the coil. A good approximation to a correction for the effect of irregular winding is made by dividing the winding into a number of sections and calculating the magnetic effect at the centre due to each section. The effect of the opening in the fixed coil for the suspension is shown to be so small that it is not wise to cramp the experiment by making it unduly small. The paper refers largely to the absolute electrodynamometer used by Guthe [see Abstracts Nos. 366 and 1904 (1906)]. F. E. S.

1912. *Factors determining Design of Kelvin Galvanometers.* **L. A. Freudenberger.** (Electrical World, 48. pp. 607–608, Sept. 29, 1906.)—A condensed mathematical discussion of the best form of coil and size of single silk covered wire to be used in winding a Kelvin astatic galvanometer. The author finds that No. 36 B and S gauge wire of 2·5 mils radius gives the best results both theoretically and practically, also that only a small gain in sensibility is realised by using graded sizes of wire in winding. E. C. R.

1913. *Alternating Current d'Arsonval Galvanometer.* **W. S. Franklin** and **L. A. Freudenberger.** (Electrical World, 48. p. 569, Sept. 22, 1906.)—The field magnets of the instrument are made of C-shaped iron stampings, the moving coil being suspended in the opening of the C. The section of the iron is 5/2 in. by 5/8 in., and the width of the air-gap 1 in. Two coils each consisting of 700 turns of No. 20 cotton insulated wire are connected in series. They are placed as close as possible to the air-gap. The magnetising current is obtained from 110-volt mains, the frequency being 133. The coils are connected with a 2-mfd. condenser, a variable inductance and a lamp board in series. The inductance is adjusted until the lamps have their maximum brilliancy, the p.d. across the condenser now being about 500 volts. In this case the magnetising current is in phase with the applied p.d., and the torque on the moving coil, through which an alternating current of the same frequency in phase with the applied p.d. passes, is a maximum. With this arrangement a sensibility of 10^{-7} amp. per mm. division of a scale at a distance of 1 m. from the coil was obtained. The authors conclude that for equal field strengths the alternating-current instrument is almost as sensitive as the direct-current instrument. A. R.

1914. *Alternating Current Kelvin Galvanometer.* **W. S. Franklin** and **L. A. Freudenberger.** (Electrical World, 48. p. 718, Oct. 13, 1906.)—The galvanometer consists of two small soft-iron magnets and a mirror fastened to a glass rod and suspended by a quartz fibre at the centre of two galvanometer coils which carry the alternating current which it is desired to measure. The axes of the magnets are in the same plane, at right angles to one another, and each is inclined at 45° to the suspending fibre. A uniform alternating magnetic field, the direction of which is almost vertical, is produced by two "Helmholtz" coils surrounding the other coils. The current for this field is obtained from the same source as the current which is to be measured. The sensitiveness of the galvanometer is from 1/3rd to 1/10th that of the ordinary Kelvin astatic instrument. The instrument illustrated has a sensitiveness of 10^{-9} amp. per mm. at 1 m. distance, and a resistance of 950 ohms. A. R.

1915. *Blondel Rectifier.* **Blondel.** (Archives d'Él. Médicale, 14. pp. 798–806, Oct. 25, 1906. Rev. Électrique, 6. pp. 97–99, Aug. 30, 1906. Paper read before the Assoc. Franç. pour l'Avancement des Sciences.)—In the model shown to the Congress, and constructed by Gaiffe, a synchronous motor worked by the alternating current drives a small mercury turbine, whose jet makes successive contacts with a number of teeth in the form of a crown. The number of teeth is half that of the number of poles (8 in this model) of the synchronous motor. The crown of teeth can be adjusted to ⅛ of a turn so as to make contact with the jet of mercury at any period in the duration of one alternation. E. C. R.

1916. *Electric Anemometer.* **R. Goldschmidt.** (Soc. Belge Élect., Bull. 23. pp. 409–414, Sept., 1906.)—The apparatus is based upon the resistance of a heated platinum wire exposed to the wind. The cooling by the wind is proportional to its velocity, and can be measured by measuring the resistance of the wire. The anemometer is calibrated by giving the wire a known velocity of transportation and noting its resistance in comparison with that of a similar wire at rest. E. E. F.

ALTERNATING CURRENTS AND MAGNETISM.

1917. *Effect of Iron on Wave-form of Current.* **F. Bedell** and **E. B. Tuttle.** (Amer. Inst. Elect. Engin., Proc. 25. pp. 601–621, Sept., 1906. Elect. Rev., N.Y. 49. pp. 550–553, Oct. 6, and pp. 595–597, Oct. 13, 1906.

Electrician, 58. pp. 130–133, Nov. 9, 1906. Abstract.)—This is a purely theoretical investigation, the method adopted by the authors being as follows: A pure sine wave of impressed e.m.f. is assumed, and the resistance of the circuit is supposed to be negligible. The current wave is assumed to consist of a fundamental and a third harmonic. It is shown that the phase displacement of the third harmonic relatively to the fundamental must lie between 30° and 180° (referred to period of third harmonic), and that corresponding to each angle of displacement there is a definite limit to the ratio of the amplitudes of the two waves. Taking the limiting value of the amplitude of the third harmonic in each case, and assuming various phase displacements, corresponding to various possible limiting current wave-forms, the authors work backwards from the e.m.f. and current waves, deducing from them the corresponding hysteresis loops. These are found not to resemble the loops commonly met with in practice, and hence the authors conclude that iron must also introduce higher harmonics than the third into the current wave. A. H.

1918. *Stress in Magnetised Iron.* **S. Bidwell.** (Nature, 74. p. 317, Aug. 2, 1906.)—According to the author the compressive stress in magnetised iron, to which he has previously called attention, is distinct from "Maxwell's stress," the value of which is $B^2/8\pi$. He shows that the stress due to the magnetisation has the value $(B^2 - H^2)/8\pi$, which becomes $B^2/8\pi$ in the case of an endless permanent magnet. This stress gives rise to a shortening strain determined by the value of Young's modulus for the specimen. The effect under consideration is illustrated by considering the case of a number of magnetised steel spheres corresponding to the molecules, and having rubber sheaths. When the spheres are arranged as the molecules in a magnetised material the rubber is under compression owing to the attraction between adjacent polar surfaces. **C. Chree.** (Ibid. p. 539, Sept. 27.)—Chree points out that in the model used by Bidwell the non-magnetic material between the iron spheres would not be subjected to stress, since the forces on the spheres due to adjacent spheres would be symmetrical. Further, the actual stress in the iron itself due to the polar surfaces will be of the nature of a tension. S. G. S.

1919. *Magnetic Variations in Iron under Torsion.* **F. Piola** and **L. Tieri.** (Accad. Lincei, Atti, 15. pp. 231–235, Aug. 19, 1906.)—In this paper the investigation [see Abstract No. 1616 (1906)] is continued to disymmetrical magnetic cycles. Given a disymmetrical cycle composed of an arc of a symmetrical cycle and an arc of return, interior to the same, the limiting line of the interior arc is within the area enclosed by the limiting lines of the symmetrical cycle. In every internal arc there is a point to which, after an infinite number of cycles of torsion, corresponds an intensity of magnetisation equal to the initial; and this neutral point is on the corresponding limiting line, and is therefore within the area enclosed by the limiting lines of the symmetrical cycle. To the various points of the internal arc corresponds an irreversible effect, which consists in an increase of the magnetisation or a diminution, according as these points are on one side or the other of the neutral point. When the internal arc indicates, in the direction in which it is traversed, a diminution of magnetisation, the points of that arc comprised between the limiting lines of the symmetrical cycle undergo, during the first elastic cycle, a variation in the magnetisation opposed to that which they undergo in succeeding cycles. A. D.

1920. *Nature of Permanent Magnets.* **E. Kempken.** (Ann. d. Physik, 20. 5. pp. 1017–1082, Sept. 14, 1906. Extract from Inaug.-Dissertation, Tübingen. Écl. Électr. 49. pp. 176–177, Nov. 3, 1906.)—Two rival views have hitherto been held with regard to permanent magnets. According to one, such a magnet is the seat of a constant number of lines, so that while changes in the reluctance of the magnetic circuit (such as those due to the approach or withdrawal of an armature) produce changes in the distribution of the flux, the total flux remains unaltered. According to the other view, the total flux undergoes changes, but the magnet behaves as if it were the seat of a constant magnetomotive force. The object of the author's experimental researches was to decide between the two theories. For this purpose a split anchor-ring of magnetised steel was used, the two halves of which were mounted in such a manner as to allow of their being separated by an accurately measured distance, and measurements were made of the flux across the air-gaps and changes of the total flux by the aid of suitable exploring coils connected to a ballistic galvanometer. The results may be summarised as follows: (1) If the reluctance of the magnetic circuit of a permanent magnet be varied so as to produce changes in the air-gap field not exceeding 170 per cent., the magnetomotive force may be regarded as having a constant value (the variation being less than 1 per cent.). (2) It is probable that the magnetomotive force remains sensibly constant for even larger changes in the reluctance. (3) During the changes of air-gap field due to changes in the reluctance, a small amount of hysteresis is observed. (4) The magnetic flux of a permanent magnet does not remain constant during changes of reluctance. [See also Abstract No. 1646 (1905).] A. H.

1921. *Heusler's Magnetic Alloys.* **K. E. Guthe** and **L. W. Austin.** (Bureau of Standards, Bull. 2. pp. 297–316, Aug., 1906. Écl. Électr. 49. pp. 256–258, Nov. 17, *et seq.*)—Describes measurements of the magnetic properties of a series of specimens of these alloys together with measurements of the magnetostriction and of the effect of a magnetic field on the thermoelectric properties. Attempts were also made to measure the mechanical properties (Young's modulus) of the alloys, but all the specimens behaved very erratically and several broke at low loads on account of internal flaws, so that the authors are unable to say more than that Young's modulus is high. Chemical analyses and magnetisation and magnetostriction curves are given for all the alloys tested, no thermal treatment having been employed. The magnetostriction is found to increase more rapidly than the magnetisation, and no contraction is found even for strong fields. No change in the thermo-e.m.f. could be observed in these alloys even when the specimens were strongly magnetised; and since Kerr's phenomenon is also believed not to occur, the authors conclude that certain properties associated with ordinary magnetic materials are absent in these alloys. W. Ros.

1922. *Critical Ranges of Heusler's Magnetic Alloys.* **E. Take.** (Ann. d. Physik, 20. 5. pp. 849–899, Sept. 14, 1906. Phys. Inst. d. Univ., Marburg, June, 1906. Electrician, 58. p. 128, Nov. 9, 1906. Abstract.)—Describes magnetometric and dilatometric measurements carried out on a series of Heusler's copper-manganese-aluminium alloys made both with and without the addition of small proportions of lead; the measurements were directed to the detection of critical points, but the results are greatly complicated by the fact that the position of the magnetic critical points is dependent upon the previous thermal history of the alloy, while some of the volume changes which occur, especially at higher temperatures, are irreversible. The author lays stress on the value of the actual observations recorded in the paper, and while giving a series of tentative conclusions admits that a wider knowledge of the constitution and structure of these alloys is necessary before the complex phenomena can be explained. [See also Abstract No. 1291 (1905).] W. Ros.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

1923. *New Unit of Quantity for Röntgen Rays.* **H. Bordier** and **J. Galimard.** (Archives d'El. Médicale, 14. pp. 667–674, Sept. 10; Discussion, pp. 568–570, Aug. 10, 1906. Paper read before the Soc. Franç. pour l'Avancement des Sciences, at Lyons.)—The unit H (of Holzknecht), which is based upon the reaction of the skin, is generally employed; but since the skin's sensibility is different for different regions in the same subject the authors propose as a less empirical and an accurately reproducible standard the use of (Freund's) solution of iodoform (2 per cent.) in chloroform. The Röntgen rays acting on this solution in the dark liberate iodine, which is titrated by colorimetric comparison with a series of standard (sealed) solutions of known iodine content. To give these standard solutions the same tint as the solutions exposed to the rays, the former are examined by daylight passed through paper stained yellow with picric acid. As unit, for which the term I is proposed, the quantity of Röntgen rays capable of liberating 1/10 mgm. of iodine when falling with normal incidence upon 1 cm^2. section and 1 cm. thickness of such 2 per cent solution, in the dark, is taken. The solution is contained in a glass tube 11·8 mm. internal diam. (1·0016 cm^2. section). The tube is enclosed in a cardboard case which contains in addition a porcelain bowl with a plug of cotton-wool moistened with chloroform, to prevent loss of chloroform from the solution to be exposed to the rays. The case is enveloped in blackened paper. The following table shows the actual values by this standard, of the four tints on the Bordier chromoradiometer [Abstract No. 1441 (1906)] and on the Holzknecht scale :—

Tint.	Units I.	Units H.
I.	3·5	5 (about)
II.	5·5	7
III.	10	14
IV.	15·5	22

The employment of the method as an integrator of luminous energy for the measurement of light-intensities is touched upon. L. H. W.

REFERENCE.

1924. *Conducting Ellipsoid in Electric Field.* **H. Benndorf.** (Akad. Wiss. Wien, Sitz. Ber. 115. 2a. pp. 391–424, April, 1906. From the Phys. Inst. d. Univ., Graz.)—A highly analytical paper in which the author obtains expressions for the potential, field, and surface distribution of charge which follow if a triaxial-ellipsoidal charged conductor is placed with any orientation in a uniform electric field. As special cases taken first are those in which the initial charge vanishes and in which the initial field is zero. Other special cases are the sphere and ellipsoid of revolution, an elongated ellipsoid at right angles to the field, the disc ellipsoid in fields parallel and perpendicular to its short axis, and the capacities of these two limiting cases of ellipsoids. E. H. B.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1925. *Behaviour of Metallic Oxides at very High Temperatures.* **F. O. Doeltz.** (Metallurgie, 3. pp. 212–216, April 8; 233–238, April 22, 1906.) **F. O. Doeltz** and **C. A. Graumann.** (Ibid. pp. 372–375, June 8, and pp. 406–408, June 22, 1906.)—The experiments were made with zinc oxide, cadmium oxide, and lead oxide. For the lower temperatures the oxides were heated in a platinum boat, but above 1,400° C. the author's micro-furnace was employed. This consists of an electrically-heated (5 amps. at 1–2 volts) horizontal platinum wire 0·15 mm. diam. and 6 to 8 mm. long. The material to be examined is spread upon the wire and observed through a microscope. Below 1,200° zinc oxide loses practically nothing, the loss gradually increasing (1 per cent. at 1,300°, 13 per cent. at 1,400°, in 2 hours) until at 1,710° immediate evaporation takes place with formation of needle-shaped crystals. The behaviour of the cadmium and lead oxides was examined up to 1,000°. L. H. W.

1926. *Physical Properties of Fused Magnesium Oxide.* **H. M. Goodwin** and **R. D. Mailey.** (Phys. Rev. 23. pp. 22–30, July, 1906. Amer. Electro-Chem. Soc. Trans., Vol. 9, 1906.)—Attention was first directed to the preparation of fused MgO for making vessels that would be chemically inert, a non-conductor of electricity, and have a sufficiently high melting-point. A small coefficient of expansion was also desired. The authors were successful in making masses of fused MgO by an arc furnace. From these masses rods or pieces of the desired size were bored by carborundum. The fused oxide when pure and uncontaminated with particles of graphite is a pure white, very hard crystalline substance. The fused surface resembles glazed porcelain. Its hardness approaches that of felspar. Its average density at 20° C. is 2·493. The melting-point by a Wanner pyrometer is between 1,890°–1,940° C. The conductivity at 800° C. is $0·01 \times 10^{16}$; at 1,150° C., $2·60 \times 10^{-6}$ in mhos per m. length and mm.^{2} section. The value of the linear coefficient of expansion from 120°–270° is given by $a_t = 10^{-8} [1140 + 0·92 (t - 120)]$, when an Abbé-Fizeau dilatometer is employed. This value is nearly equal to that of platinum, and this close agreement should prove a valuable property in the construction of apparatus. Fused MgO possesses n a remarkable degree the ability to withstand the chemical action of many neutral salts at high temperatures. W. W. H. G.

1927. *Electric Vacuum Furnace.* **W. C. Arsem.** (Amer. Electrochem. Soc., Trans. 9. pp. 153–171; Discussion, pp. 171–172, 1906. Amer. Chem. Soc., Journ. 28. pp. 921–935, Aug., 1906.)—Previous work *in vacuo* at high temperatures has been confined to experiments with quartz and porcelain tubes. In the vacuum furnace used by the author the attainable temperature is limited only by the vaporisation of carbon. A special type of resistance furnace enclosed in a vacuum chamber is used, with means for continuous cooling of the parts liable to be injured, and so designed that the substance in the crucible is always visible through a window of mica at the top of the furnace. The heater is a helix of carbon or graphite, made by sawing a slot in a hollow cylinder so proportioned that the voltage across the heater does not exceed 50 volts, in order to avoid excessive Edison-effect, and the tendency to arc across to the screen. Good results have been obtained with a heater 2 in. outside diam., 1⅝ in. inside diam., and having 10 turns in a length of 7½ in. The screen to prevent radiation is a double-walled cylindrical box of Acheson graphite filled with graphite powder. Crucibles of graphite or magnesia and other substances are placed within the heater. The furnace was calibrated by plotting the kilowatts employed against the temperature ascertained from substances of known melting-point. It was found that the furnace gave the same phenomena as is observed in a glow-lamp. The furnace is very convenient for preparing alloys, the study of chemical reactions, and the determination of melting-points. The life of the heater varied from ¾–9 hours, according to the temperature, which ranged from 3,100–2,500° C. **W. W. H. G.**

1928. *Copper Steels.* **P. Breuil.** (Comptes Rendus, 143. pp. 346–348, Aug. 13, and pp. 377–380, Aug. 27, 1906.)—In steels containing from 0·56 to 0·79 per cent. carbon and 0·5 to 20 per cent. Cu, Ar_1, varied but little, occurring at from 575° to 600° C. There is an arrest at about 1,000° C. when copper separates, *i.e.*, with over 3 per cent. Cu; but it is only when the copper content exceeds 10 per cent. that any difficulty in forging is experienced due to the presence of free Cu. The following are some of the results of mechanical tests of this series and the steels referred to in Abstract No. 1480 (1906):—

	Carbon, per cent.	Copper, per cent.	Tensile strength, kg. per sq. mm.	Elongation, per cent.
As rolled.	0·15 to 0·18	0·5	47·1	25·5
		4·0	77·1	13·0
	0·35 to 0·38	0·5	65·5	20·0
		4·0	97·1	11·2
	0·56 to 0·79	0·5	83·5	12·0
		10·0	125·5	2·5
Annealed at about 900°.	0·15 to 0·18	0·5	41·6	28·0
		4·0	50·3	22·0
	0·35 to 0·38	0·5	54·7	23·5
		4·0	68·5	16·0
	0·56 to 0·79	0·5	71·2	16·5
		10·0	82·5	10·0
Quenched at 870° and 830°.	0·15 to 0·18	0·5	67·0	16·0
		4·0	138·0	7·0
	0·35 to 0·38	0·5	76·5	1·4
		4·0	100·2	1·4
Quenched at 870° or 830° tempered at 300°.	0·15 to 0·18	0·5	72·2	8·5
		4·0	100·0	11·0
	0·35 to 0·38	0·5	139·0	3·5
		4·0	173·0	1·5
	0·56 to 0·79	0·5	158·0	0

Under Vanderheym's shock test, Cu appears to give but little brittleness to steel. The results of torsional tests run parallel with the tensile results—elastic limit and strength are increased, and deformation at rupture, though still of fair amount, is decreased by the presence of Cu. The Brinell hardness figures also follow the tensile results; the hardness of these steels is generally greater than that of corresponding Ni steels. The presence of Cu in steel has a powerful effect in protecting it against corrosion in sulphuric acid solution. The author's conclusions with regard to the micrography of the series confirm those of Stead. The useful steels (those containing up to 4 per cent. Cu) are characterised by their fineness of structure, which is more sorbitic with increasing Cu. It is concluded that Cu steels are worth attention as competitors with steels containing Ni and other costly additions. **F. R.**

1929. *Manganese-Silicon Alloys.* **F. Doerinckel.** (Zeitschr. Anorg. Chem. 50. 2. pp. 117–126, July 30, 1906. Metallog. Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—A complete solidification diagram for these alloys is given. The author's results indicate the existence of Mn_2Si, solidifying at about 1,310°, and of MnSi, solidifying at about 1,280°. There are also three eutectics: at about 11 per cent. Si (1,075°); at 30 per cent. Si (1,239°); and at about 50 per cent. Si (1,136°). The first does not occur below about 11 per cent. Si. The third extends from about 37·5 to 100 per cent. Si. There is an analogy between these alloys and those of Fe and Si. F. R.

1930. *Crystallisation of Gold in the Solid State.* **G. T. Beilby.** (Engineering, 82. p. 312, Sept. 7, 1906. Abstract of paper read before the British Assoc. at York.)—Gold is unaffected by heat at all temperatures short of its melting-point, except in the range from 220° to 275° C., in which the amorphous structure is changed into the crystalline [see Abstract No. 2506B (1904)]. The experiments included observations of the mechanical properties, thermo-e.m.f., and microstructure of gold wires which had been suitably treated. F. R.

1931. *Recent Researches on Industrial Alloys.* **L. Guillet.** (Soc. d'Encouragement, Rev. de Métallurgie, Mém. 3. pp. 87–111, July 1, 1906.)—In addition to a review of recent work on special steels and alloys, the author gives some new results. The properties of Al-bronzes are considerably affected by heat treatment. A 10·1 per cent. Al-bronze as cast had a tensile strength of 15·5 tons per sq. in., with 20 per cent. elongation; quenched at 750°, 21·5 tons and 17·5 per cent. elongation; quenched at 850°, 23·5 tons and 7 per cent. elongation. The 7 per cent. Al-bronze is softened by quenching. Ni has little influence on the strength of Cu, until its percentage exceeds 15, when it hardens the copper somewhat, and increases the elastic limit very considerably. When these alloys are drawn the tensile strength is but little increased, the elastic limit being enormously raised, however. The eutectic in phosphorus-copper alloys is placed at 10 per cent. P [see also Abstract No. 1630 (1906)]; the freezing-point curves of this series, and of Cu-Si are given. In the latter there is a solid solution up to about 7 per cent. Si, and at about 20 per cent. Si a compound is observed; but Cu_4Si, noted by Lebeau, is not confirmed. Two compounds are indicated in the Cu-V series; from 0 to 7, and above 25 per cent. V, the alloys are homogeneous. Cr and W will not alloy with Cu. The author has found that Al in steels containing sufficient Ni to be martensitic, changes them to pearlitic; thus similarly Al may raise the critical point of Mn, which then becomes magnetic at ordinary temperatures. The magnetic Al-Mn alloys consist of a solid solution; this negatives the theory which requires a *compound* to explain the magnetism. Alloys of Al with low percentages of Mn are useful industrially, resisting corrosion by sea-water better than other Al alloys. F. R.

1932. *Corrosion of Wrought Iron and Steel.* **H. M. Howe.** (Eng. News, 55. p. 715; Discussion, p. 728, June 28, 1906. Paper read before the Amer. Soc. for Testing Materials, June 22, 1906. Eng. Mag. 31. pp. 750–752, Aug., 1906.)—The chief differences between iron and steel which will result in their rates of corrosion under given conditions being different are: (1) Blow-holes exist in steel but not in iron; (2) steel contains more Mn than wrought iron, but from the fact that in short time tests steel does not rust materially faster than iron, it is inferred that Mn is not a serious cause of rusting [see also Abstract No. 144B (1906)]; (3) steel is generally richer than iron in cementite, and contains much less slag; in one case cementite, in the other slag, may hasten corrosion by local galvanic action, or retard it mechanically as paint does. The relative rate of corrosion of iron and steel may hence change as corrosion proceeds, the iron being in the long run the more resisting. In the *discussion*, **F. N. Speller** said that in a large series of tests iron and steel pipes were found to offer about the same resistance to corrosion, the steel not corroding over 10 per cent. more than iron. Two locomotives were fitted, one with iron, the other with steel tubes, and observed until the tubes were worn out; there was no superiority of either. The electrolytic p.d. between iron and its slag is as high as 0·2 to 0·3 volt. F. R.

1933. *Dissociation Constants of Weak Acids.* **E. Bauer.** (Zeitschr. Phys. Chem. 56. pp. 215–222, July 17, 1906. Inst. f. Physikal. Chemie, Berlin, July, 1905.)—The author has tested Sand's method [Abstract No. 428 (1905)] for determining the dissociation-constant of a weak acid the solution of which is not stable, by applying it to the investigation of certain weak organic acids. The constants obtained with butyric and benzoic acids were in good agreement with those deduced from conductivity measurements; the error of experiment is about 3 per cent. The dissociation-constant of nitrous acid is found to be $6{\cdot}4 \times 10^{-4}$, *i.e.*, it is not a very weak acid, and the solutions of the potassium salt are not appreciably hydrolysed. The migration velocity of the NO_2' ion is calculated to be 58. [See Abstract No. 888 (1900).] T. S. P.

1934. *Chemical Action of Ultra-violet Light.* **W. H. Ross.** (Amer. Chem. Soc., Journ. 28. pp. 786–793, June, 1906.)—Results are given of an investigation of the action of ultra-violet light in decomposing solutions of iodides, and in reducing ferric salts and chlorates and bromates. The source of light employed consisted of an oscillatory spark passing between aluminium terminals joined in the secondary circuit of a large induction coil used as a transformer, a large Leyden jar being joined in parallel with the secondary. The iodine set free from solutions of iodides varies inversely with the square of the distance of the solution from the source of light. The chlorates and bromates differ from the iodides and ferric salts in that variation of the concentration of their solutions from N/2 to N/50 produces no appreciable difference in the reduction. T. H. P.

1935. *Ozonisation in the Point Discharge.* **P. Cermak.** (Deutsch. Phys. Gesell., Verh. 8. 13. pp. 268–276, July 15, 1906.)—The equilibrium between the ozonising and de-ozonising effect of the point discharge in oxygen depends upon the manner of charging, the purity of the oxygen, the current, temperature, and pressure, and the shape of the point. With greater current-densities the proportion of ozone attainable diminishes. It increases in the cold and under pressure. The best diam. of wire is 1 mm., both for positive and negative discharge. Au and Pt are the only suitable materials. E. E. F.

1936. *Behaviour of Vapours of Methyl Alcohol and Acetaldehyde with High-frequency Discharges.* **H. Jackson** and **D. Northall-Laurie.** (Chem. Soc., Journ. 89. pp. 1190–1193, Aug., 1906.)—The electrical discharges were obtained from a machine similar to those used for therapeutic purposes, and were of very short duration so as to avoid the formation of secondary products. In the case of methyl alcohol the primary change is to CO and hydrogen;

acetaldehyde vapour breaks up chiefly into methane and CO, but acetylene and water are also produced simultaneously, though in smaller quantities. In both cases the changes are reversible. D. H. J.

1937. *Model and Experiment to Illustrate Alteration of Concentration during Electrolysis.* **W. Palmaer.** (Zeitschr. Elektrochem. 12. pp. 511–518, July 27, 1906.)—The author describes a simple wooden model to illustrate the alteration in concentration of an electrolyte owing to the different velocities assumed by the anions and kathions when a current is passed through the solution. The following lecture-experiment is recommended for the same purpose: A glass U-tube having an internal diam. of 5 mm. and a height of about 70 cm. is filled with 4-normal hydrochloric acid, which is electrolysed by means of a platinum kathode and a silver anode; owing to the velocity of the H·-ions being greater than that of the Cl′-ions, the anodic solution loses more HCl than the kathodic liquid and becomes specifically lighter, so that the liquid stands at different heights in the two limbs of the tube. T. H. P.

1938. *Electrolytic Precipitation of Lead from Acetate Solutions.* **R. C. Snowdon.** (Journ. Phys. Chem. 10. pp. 500–501, June, 1906. Amer. Electrochem. Soc., Trans. 9. pp. 223–224; Discussion, pp. 224–227, 1906.)—With a lead anode, a rapidly rotating tubular copper kathode, and a current density of 0·5 amp. per sq. dm., a solution containing lead acetate and acetic acid deposits lead in a crystalline and adherent form, almost entirely without the flaky appearance observed when a stationary kathode is employed. A current density of 1·5 amps. per sq. dm. may be used if the solution contains 1 gm. of gelatine per litre. T. H. P.

1939. *Electrolytic Corrosion of Bronzes.* **B. E. Curry.** (Journ. Phys. Chem. 10. pp. 474–499, June, 1906. Amer. Electrochem. Soc., Trans. 9. pp. 173–196; Discussion, pp. 196–198, 1906.)—The author gives the results of electrolytic corrosion tests of various bronzes in some of the more common salt solutions. The α bronzes corrode more rapidly than any others, but undergo very little change in the process. The $\alpha + \delta$ and $\alpha + \beta$ bronzes become rich in tin on the surface. The β, δ, $\beta + \gamma$, $\delta + Cu_3Sn$, $Cu_3Sn + \epsilon$, and ϵ bronzes undergo little change and tend to become passive. The $\epsilon + Sn$ bronzes become rich in copper on the surface and tend to disintegrate as the tin dissolves. The cause for certain of the bronzes becoming passive is found to be the formation of a film of stannic oxide; no bronze becomes passive in chloride solutions. The ϵ bronze withstands corroding action better than any other. T. H. P.

1940. *Electrolysis of Fused Potassium Nitrate.* **Duparc** [experiments by **C. Couchet** and **R. C. Schlosser**]. (Zeitschr. Elektrochem. 12. pp. 665–666, Aug. 31, 1906.)—A preliminary, mainly tabular account. The electrolysis of fused potassium nitrate by direct and alternating currents yields varying quantities of nitrite and alkali oxide; with metallic electrodes also the oxides of these metals and, further, ferrate and aluminate. The best nitrite-yield results with graphite electrodes; the metals give less nitrite, the order being Fe, Cu, Ni (lowest nitrite yield), and more alkali. With higher temperatures and current density all the yields improve; the influence of time is also studied. The composition of the anode gases varies in the course of the electrolysis; the gases are: CO_2 from 73 to 83 per cent.; CO from 3 to 4·5 per cent.; O from 4 to 10 per cent.; NO from 4·5 to 15 per cent. H. B.

1941. *Behaviour of Platinised Electrodes.* **H. D. Law.** (Faraday Soc., Trans. 2. pp. 72-73; Discussion, p. 74, Aug., 1906.)—When reducing arsenious oxide to arseniuretted hydrogen, Chapman and Law observed that, if M is the trace of arseniuretted hydrogen left in the solution at the end of the experiment, K the amount of unchanged arsenious oxide, and P a factor depending upon the potential of the hydrogen, the relation $M = KP$ will hold. Since M may be regarded as constant, the reactions should be diminished as the kathode potential is raised. As hydrogen is liberated at the lowest potential from platinised Pt kathodes, the author used such kathodes in the investigation of the electrolytic oxidation of aromatic aldehydes when reduction was not desired. He found, however, that the hydrogen absorption was almost complete, showing that an energetic reduction had taken place. Alcoholic solutions of benzaldehyde, containing 5 per cent. of sulphuric acid, were applied. The activity diminished when the same kathode was used in consecutive experiments; when the kathode was kathodically polarised, the activity was very small. As the platinisation had been effected in solutions of platinic chloride which liberated chlorine, the last-mentioned kathode was anodically polarised; in that case it reduced even benzyl alcohol and toluene. With inert chlorides, lead, &c., the reduction of benzaldehyde yields hydrobenzoin and a little benzyl alcohol; with the platinised electrodes it yields a small quantity of benzyl alcohol and apparently an aliphatic hydrocarbon. In the *discussion,* **N. T. M. Wilsmore** pointed out that the result seemed to contradict the view of Tafel and others, that the relative reducing power of an electrode was connected with the excess voltage required to liberate hydrogen on the electrode surface; thus lead, with a high excess voltage, was a powerful reducing agent. **F. M. Perkin** also emphasised that these researches might help us to understand the nature of supertension. The **Author**, in reply, referred to the influence of the surface of the electrode and of finely-divided metals, *e.g.*, nickel. H. B.

1942. *Electrolytic Chlorine, especially Chlorine made by the Elektron Process.* **P. Ferchland.** (Elektrochem. Zeitschr. 13. pp. 114-119, Sept., 1906.)—Electrolytic chlorine has frequently been regarded as a "stronger" modification of chlorine, as it combines with lime under heating and under formation of chlorate and chloride. Various processes have been proposed to convert this chlorine into ordinary chlorine. According to the author commercial electrolytic chlorine contains from 10 to 12 and more per cent. of CO_2, whose importance had been underrated because faulty analytical methods were applied. He absorbs the chlorine by mercury, and describes a simple apparatus for quantitative chlorine determination, which the men of the Chemische Fabrik Elektron have been using since 1896. The percentage of CO_2 in the Cl does not increase with the current density in the electrolytic cell. If a double-wall diaphragm is used, the space between the two walls becomes charged with caustic alkali, and the whole of the oxygen of the alkali which penetrates over to the anode furnishes CO_2. By circulating KCl solutions between the two walls, the author reduced the CO_2 percentage in experiments to 1 or 2; in the works the percentage of CO_2 has never been diminished below 6. When the kathode compartment becomes concentrated with alkali, chlorate crystals may be deposited from the hot solution. Diluted solutions of KCl may give 30 per cent. of CO_2. Such solutions are not employed at Griesheim, but with high current densities and porous carbon anodes the solution may locally become impoverished, when the destruction of the anodes will be rapid. The "Elektron" chlorine does not contain oxygen nor CO, both of which Winteler had found in electrolytic chlorine; but Winteler experimented at ordinary temperatures, not with hot solutions. Electrically-baked carbons gave the purest chlorine. H. B.

1943. *Simple Continuous Electrolytic Chlorate Process.* **A. Wallach.** (Zeitschr. Elektrochem. 12. pp. 667–668, Aug. 31, 1906. Communication from the Instit. f. Physikal. Chemie u. Elektrochemie d. techn. Hochschule, Karlsruhe.)—A continuous feed of KCl is recommended, and the crystallised $KClO_3$ removed from time to time. The two electrodes, platinum wire gauze, form concentric cylinders not reaching down to the bottom of the glass cell; the blades of the stirrer move in the lower portion of the cell, below the electrodes. The 25 per cent. solution of KCl is mixed with a little $K_2Cr_2O_7$, and continuously replenished by drops of KCl. When some concentrated hydrochloric acid is added to the electrolyte about every 7 min., the yield of chlorate is 86 per cent. with currents of 1·5 amps./cm.^{2} at 5·6 volts at 70° C. When the hydrochloric acid is directly added to the solutions of KCl in the replenishing bottle, the yield rises to 92 and 95 per cent. The resulting chlorate is easily obtained white (not yellow with chromate), and of purity 99·5 per cent. The advantage of the simple arrangement is that the brittle platinum electrodes need not be taken out of the cell. H. B.

1944. *Diaphragms used in Electrolysis and Formulæ proposed for calculating the Yield.* **U. Lombardi.** (Gazzetta Chim. Ital. 36. 1. pp. 378–387, 1906.)—The author shows that none of the formulæ known up to the present can be used in practice for calculating the yield in the electrolysis of the alkali chlorides. It is difficult to find one which can be so used, since, even if empirical, it has to take into account too many factors, some of which cannot be determined in practice; this is the case, for example, with the diffusion of the hydroxide through the diaphragm, which depends on the nature, thickness, and area of the diaphragm, and also with the electrical endosmose. As regards the behaviour of the different types of diaphragm in the electrolysis of the alkali chlorides and the criteria for determining the choice of one rather than the other, nothing absolute can be asserted. In normal conditions the fall of potential produced by a porous septum varies from a minimum of 0·1 to a maximum of 0·2 volt. Another factor varying greatly, even with diaphragms of the same type, is the permeability, which depends on the structure of the material. Thus, the porous septa of Pukall and Villeroy have numerous very small pores, which, on the one hand, increase the resistance, and, on the other, render the diffusion slower and the permeability less. Septa of asbestos are more porous and far more permeable, since their structure is that of a felt in which the fibres are interlaced; electrically they are less resistant and the diffusion through them proceeds more easily, so that, in the electrolysis of the alkali chlorides, the concentration of the hydroxide, which for economy's sake should not exceed a certain value, is less than with other porous septa. Diaphragms of cement are more resistant and less porous than the others; their pores are irregular and too large, so that the diffusion is greater than with other diaphragms, but they are more economical than the latter. The choice as regards type of diaphragm in any particular case depends mainly on the conditions and on the chemical nature of the substance to be electrolysed. T. H. P.

1945. *Reduction of Nitro-Compounds by Alkaline Solutions of Stannous Oxide.* **H. Goldschmidt and M. Eckardt.** (Zeitschr. Phys. Chem. 56.

pp. 385–452, Aug. 17, 1906.)—The very carefully conducted researches have essentially chemical interest; some features and the general discussion concern electro-chemistry. Solutions of stannous oxide in caustic soda contain chiefly the monosodium stannite SnO_2HNa (as Hantzsch had observed), more concentrated solutions also the distannite SnO_2Na_2. The former can be prepared electrolytically when an anode rod of tin is electrolysed in caustic soda; it is advisable to rotate the anode, as the tin easily becomes passive, in which case the current has to be reversed temporarily. As the tin solution is very easily oxidised, all operations are performed in an indifferent atmosphere of H, N, or coal gas. The reductions are effected by mixing the stannite with the substance, the *o*-, *m*-, *p*-isomers of nitraniline, nitrophenol, nitrobenzaldehyde, and nitrobenzoic and nitrobenzosulphonic acid; the electric current is not applied. H. B.

1946. *Technical Combustion of Nitrogen.* **F. Foerster.** (Zeitschr. Elektrochem. 12. pp. 529–538; Discussion, pp. 538–541, Aug. 3, 1906. Paper read before the Deutsch. Bunsen Gesell., Dresden, May 21, 1906.)—The chief experiments referred to are those of Brode, Bradley and Lovejoy, Kowalski and Moscicki, and particularly Birkeland and Eyde. According to the author's own experiments, the same electrical energy would yield the same amount of nitrogen oxides, whether at high or low potential. Muthmann and Hofer are mentioned in connection with the proposals for improving the yield. In the *discussion*, **F. Haber** rectified one of the figures he had given elsewhere. **Brode** and **Stavenhagen**, and further **Byk** and **Arndt** spoke about the colours of the arc flames and the re-decomposition of the NO in the pale flames. **Warburg** considers that the silent discharge always yields both ozone and nitrogen oxide, which **Foerster**, relying on Berthelot, had not assumed. **Nernst** regards the oxidation of nitrogen as a purely thermal processs. **Warburg** believes that rays of small wave-length and the impacts of electrons both play a part in the ozonisation and in the formation of nitrogen oxides. **Escales** inquired whether the high temperature was supposed to dissociate the nitrogen. **Nernst** did not think that any dissociation of nitrogen had been observed, nor did he believe in any activation of pure nitrogen. **Hempel** confirmed Stavenhagen's statement that the resulting nitrogen oxides could not entirely be liquefied; condensation was, however, possible when the gases were filtered through cotton-wool. H. B.

1947. *Ferromanganese Anodes in Caustic Soda Solutions.* **G. R. White.** (Journ. Phys. Chem. 10. pp. 502–513, June, 1906. Amer. Electrochem. Soc., Trans. 9. pp. 255–264, 1906.)—The appearance of a green colour—indicating the formation of manganate—sometimes observed when ferromanganese electrodes are used in the electrolysis of caustic alkali solutions is shown to be due to the presence of reducing substances as impurities. If these latter are excluded, permanganate alone is formed, in both 2 per cent. and 10 per cent. potassium hydroxide solution, and only at a high temperature (95°) does any reduction to manganate take place. This reduction is effected by the hydrogen evolved at the kathode; no spontaneous evolution of oxygen could be observed, even after the lapse of three months. The action of manganese on potassium hydroxide solution without a current yields $Mn(OH)_2$, which can be oxidised electrolytically to MnO_2 but not to permanganate. In the anodic formation of the latter, there are hence no intermediate, less highly oxidised compounds formed. T. H. P.

1948. *Technical Conversion of Nitrogen Oxides into Nitric Acid and Nitrates.* **J. Klaudy.** (Zeitschr. Elektrochem. 12. pp. 545–549; Discussion, pp. 549–551, Aug. 3, 1906. Paper read before the Deutsch. Bunsen-Gesell., Dresden, May 21, 1906.)—The gases resulting from the oxidation of nitrogen at high temperatures, might be passed into lead chambers or directly mixed with sulphur dioxide and steam (as proposed by Birger and Halvorsen), utilised in manures, absorbed in the plate towers of Lunge and Rohrmann, or by hot water; they might be concentrated by distillation, by dehydration, or by forcing air through the dilute acid; oxidation of the nitrite by ozone has also been suggested. The great dilution of the gases renders all these processes difficult. In the *discussion,* **Biltz** raised the question of the formation of pentoxide. **Warburg** and **Leithäuser** mentioned that the gases are readily absorbed by diluted caustic soda in the presence of ozone, but that the silent discharge does not yield any ozone if traces of N_2O_4 are present. This absorption was confirmed by **Foerster,** who referred to experiments of Grolée. **Helbig** stated that N_2O_4, both gaseous and liquid, is readily absorbed by ozone and oxidised to N_2O_5. **Russ** said that he had quantitatively oxidised potassium nitrite to nitrate by means of ozone, not with oxygen. H. B.

1949. *Electrochemistry of the Iodine-Oxygen Compounds.* **E. Brunner.** (Zeitschr. Phys. Chem. 56. pp. 321–347, July 31, 1906. From the chem. Inst. d. Univ., Greifswald.)—The author experiments with solutions of iodine in potassium iodide which contain in addition potassium chloride, in normal concentration, and some hydrochloric acid or alkali. The experiments are continued until the liquid near one of the electrodes is depleted of iodine; the then observed current intensity is his kathodic (or anodic) limiting current, and the reactions corresponding to these limiting currents—two for each electrode—are particularly studied. Only in the diluted solutions do his observed and calculated potentials agree; the observed potentials are much higher than the calculated values in the concentrated solutions. The author does not consider that the air of his—not hermetically sealed—cell could be concerned in this discrepancy, as Sackur had suggested [see Abstract No. 1330 (1906)]; he rather thinks that Sackur's electrolytes were not free of iodate. He concludes that iodate is only formed directly from iodite, or that iodate is genetically only related to iodite, and that the chemical resistance to be overcome in passing from IO_2' to IO_3' is small, while the resistance between IO_2' on the one side, and IO', I', and I_2 is great. Reference is made to Weigert, Bray, Tafel, Haber, Foerster, and Gyr. Further particulars are to follow. H. B.

1950. *Hermaphroditic Elements (Tellurium).* **M. Le Blanc.** (Zeitschr. Elektrochem. 12. pp. 649–654, Aug. 24, 1906. Communication from the Inst. f. physikal. Chemie u. Elektrochemie d. techn. Hochschule, Karlsruhe.)—Tellurium does not dissolve in normal caustic potash solution when the alternating-current arrangement of the author and Schick [see Abstract No. 1233 (1904)] is used. Normal caustic potash does not indeed dissolve tellurium, nor selenium, when all access of oxygen is prevented, while sulphur and the halogens are dissolved. Concentrated solutions of potash attack Te. In 10*n* solutions of KOH alternating currents dissolved at 22,000, 1,000, 500, 125, 12 alternations per min., 2·8, 15·9, 19·8, 28·8, 81·6 per cent. of Te, while 1·1, 11·2, 17·6, 37, 72 per cent. of Cu passed in solution in $KHSO_4$ at 100° at the same time. Te gives supersaturated solutions. It would appear that the same electrode can form and deposit tellurium ions. Equilibrium would result when the potential-gradients $Te/Te^{\cdot\cdot\cdot\cdot}$ and Te/Te'' are equal. Potential determinations with Te in normal KOH did not give constant values. Warth is making electrolytic experiments. [See also Abstract No. 206 (1906).] H. B.

1951. *Anodic Oxidation and Passivity.* **E. Müller** and **F. Spitzer.** (Zeitschr. Anorg. Chem. 50. 4. pp. 321–354, Sept. 21, 1906. Elektrochem. Laborat. d. techn. Hochschule, Braunschweig, July 14, 1906.)—During their investigation of the electrolytic oxidation of ammonia [see Abstract No. 439 (1906)], the authors made use of platinum anodes coated with metallic oxides. The electrolytic preparation of these oxide anodes is described. A solution of copper sulphate, ammonia, and caustic soda deposits a black coating of 95·52 per cent. CuO, 4·24 H_2O, and 0·5 per cent. possibly of copper peroxide; the oxide CuO, which is formed without any change in the valency of the copper, is dehydrated by the current and pressed upon the anode; the blue solution of copper is itself dehydrated by the current, while heating does not change its colour. Similar oxides were anodically deposited from salts of Ag, Ni, Co, Al; ferri-tartrate gave only a faint rust-coloured film on the platinum anode. The authors calculate the potentials of the formation of these oxides after Nernst; the formation may or may not be accompanied by a change of valency of the metal. The passive state seems to be connected with an oxidation. Yet the oxidation might merely be an accessory phenomenon of the passivity. As, however, oxygen is liberated from the platinum anode coated, visibly or invisibly, with the oxide of one of the metals, Co, Ni, Fe, from its alkaline solution in the absence of this metal, at the same potential at which the respective polarised metal liberates oxygen, the connection between passivity and oxidation seems to be established. H. B.

1952. *Electrolytic Oxidation and Reduction by Vanadium Compounds.* (Electrochem. Ind., N.Y. 4. p. 323, Aug., 1906.)—E. Oppermann's patent (U.S. Pat. 823,435) concerns the use of small quantities of vanadium salts in the electrolytic oxidation or reduction of organic substances, the higher oxides of vanadium acting as oxidising agents, the lower ones as reducing agents. Vanadium compounds in an electrolytic bath are, further, excellent depolarisers both at the anode and kathode. For the oxidation of anthracene a 20 per cent. solution of H_2SO_4, in which is dissolved about 1 per cent. of vanadic acid, is introduced into a vessel lined with lead, which serves as anode, the kathode being also of lead. Finely-powdered anthracene is then slowly added with constant stirring, and the mixture heated to about 80° C. A current density of 300 amps. per sq. m. is employed for the electrolysis, the voltage being 1·6, and after a short time anthraquinone is produced which may be separated by filtration. The oxidation of aniline to quinone, and the reduction of azobenzene and azoxybenzene by the process are referred to in the specification. W. H. St.

REFERENCES.

1953. *Conductivity of Aqueous Solutions of Radium Bromide.* **F. Kohlrausch** and **F. Henning.** (Ann. d. Physik, 20. 1. pp. 96–107, May 11, 1906.)—A fuller account [see Abstract No. 1752 (1904)].

1954. *Action of Light on Potassium Ferrocyanide.* **G. W. A. Foster.** (Chem. Soc., Journ. 89. pp. 912–920, June, 1906.)—Experiments carried out with a "Uviol" lamp and a Heræus quartz mercury-vapour lamp as light sources. L. H. W.

1955. *Remarks on a Thermochemical Law of J. Thomsen.* **E. Bose.** (Phys. Zeitschr. 7. pp. 503–505, July 15, 1906.)—Thomsen has stated that, at or near the boiling-points of mixtures of alcohols and water, the mixing or separating of the alcohol and water proceeds without evolution or absorption of heat. By determining the heats of mixing of water with methyl, ethyl, and propyl alcohols, the author finds that the above law holds most closely for ethyl alcohol, but that even in this case it is only roughly approximate. T. H. P.

1956. *Relation of Heat of Vaporisation to Boiling-point.* **E. C. Bingham.** (Amer. Chem. Soc., Journ. 28. pp. 723–731, June, 1906.)—The author shows that the values of Trouton's constant increase quite regularly according to the equation $\lambda'/T_0 = 17 + 0{\cdot}011T$. The divergences in the case of the associated liquids have been considered to be a measure of the association. A. F.

1957. *Material for Incandescent Gas Mantles.* **W. Bruno.** (Zeitschr. Elektrochem. 12. p. 520, July 27, 1906. Paper read before the Verein Deutscher Chemiker in Nürnberg, June, 1906.)—In place of cotton and ramie-fibre for incandescent mantles the author recommends the use of an artificial fibre of copper-cellulose. Thorium oxide prepared from the nitrate is also advantageously replaced by a preparation obtained by igniting the hydroxide. Mantles made from these materials are from forty to fifty times as resistant towards shock as those prepared in the old way. T. H. P.

1958. *Explosive Combustion of Hydrocarbons.* **W. A. Bone** and **J. Drugman.** (Chem. Soc., Journ. 89. pp. 660–682, April, 1906. Eng. Rev. 14. pp. 456–458, June, 1906.)—It has been previously shown [see Abstracts Nos. 2387 (1904) and 873 (1905)] that the slow combustion of a hydrocarbon may be regarded as a process involving the initial formation of unstable hydroxylated molecules, which subsequently undergo thermal decompositions into simpler products. The authors now show that this theory may be extended to hydrocarbon flames, and that, in so far as the immediate result of encounters between hydrocarbon and oxygen molecules is concerned, there is probably no real difference between slow and rapid combustion. T. H. P.

1959. *Sublimation of Sulphur at Ordinary Temperatures.* **R. J. Moss.** (Roy. Dublin Soc., Proc. 11. 10. pp. 105–106, June, 1906.)—The author gives the first record of the actual formation of crystals of sulphur by sublimation *in vacuo* at the ordinary temperature. The experiment was started 25 years ago when some pieces of sulphur were placed in an exhausted glass tube. No sublimate was noticed for the first 20 years. The side of the tube farthest from the wall on which it is hung, is now studded with small crystals, of which the largest is not more than 0·2 mm. in length. D. H. J.

1960. *Electric Furnaces for High and Low Pressures.* (Electrochem. Ind., N.Y. 4. p. 191, May, 1906.)—Two types of furnace are outlined from the patents of H. N. Potter (U.S. Pat. 814, 726 and 7). In the first a high pressure can be applied during the heating process, while in the second the heating can be accompanied by a reduced pressure, whereby in some cases an improved efficiency or greater velocity of reaction is obtainable. The mechanical design is fully worked out in the original specifications. L. H. W.

1961. *Ferro-tungsten Compounds.* **E. Vigouroux.** (Comptes Rendus, 142. pp. 1197–1199, May 28, 1906.)—By heating together black oxide of iron and tungsten dioxide in the presence of aluminium, iron-tungsten alloys have been prepared containing up to 46·25 per cent. tungsten. These, after separating the free iron by treatment with dilute hydrochloric acid, yield in all cases a definite compound, containing 68·70 per cent. tungsten, and corresponding to the formula Fe_3W_2. [Errata on p. 1366.] W. H. Si.

1962. *Heat Treatment of Cast Iron.* **P. Munnoch.** (Eng. Rev. 14. p. 295, April, 1906. Abstract. From the Foundry Trade Journal.)—Gives some examples of the further treatment of cast iron. When grey cast-iron bars were annealed, transverse strength was diminished by about 10 per cent., but total deflection was increased. When annealed bars were heated to and quenched from 650°–800° C., the transverse strength and deflection were considerably increased, and the content of combined carbon was also increased with increasing quenching temperature——*e.g.*, a cast iron quenched from 850° contained 0·35 per cent. combined carbon, and a piece of the same iron quenched from 950° C. contained 0·96 per cent. combined carbon. F. R.

1963. *Microstructure of Copper Alloys.* **J. Jacobsen.** (Soc. Chim. de Belgique, Bull. 20. pp. 214–230, 1906.)—A preliminary paper. The microstructure of pure copper and several bronzes and brasses examined by the author is illustrated in a number of plates. Each specimen was also submitted to mechanical tests. The following conclusions are arrived at: (1) Alloys showing good results in both tensile and shock tests have a homogeneous and regular structure (crystal axes all same way). (2) Alloys showing poor results in the mechanical tests have neither a homogeneous nor regular structure. Alloys which offer a high resistance to shock, but give poor results in tensile tests, show a homogeneous but irregular structure. L. H. W.

1964. *Thermal Study of Alloys of Aluminium and Magnesium.* **W. Louguinine** and **A. Schükareff.** (Soc. d'Encouragement, 108. Rev. de Métallurgie, pp. 19–31, March 31, 1906.)—From the results of measurements of the amounts of heat developed on dissolving Al, Mg, and various alloys of the two metals in hydrochloric acid, the author calculates the heats of formation of MgAl, $MgAl_2$, $MgAl_3$, $MgAl_4$, $MgAl_5$, $AlMg_2$, and $AlMg_3$. In the case of only one of these compounds, namely, MgAl, can it be affirmed that its formation is accompanied by evolution of heat, which even here is very small in amount. T. H. P.

1965. *Influence of Silver Nitrate on the Solubility of Silver Nitrite.* **R. Abegg** and **H. Pick.** (Ber. Deut. Chem. Gesell. 38. pp. 2571–2574, 1905.)—The values obtained by Naumann and Rücker [see Abstract No. 1323 (1906)] for the solubility-product $Ag^{\cdot} \times NO_2'$ in presence of silver nitrate are inconstant because these authors have assumed that in a saturated solution of the nitrite all the molecules are ionised. The present authors show that at 25° only 55 per cent. of the nitrite is ionised; taking this into account, the solubility product for the pure nitrite is $2{\cdot}1 \times 10^{-4}$, and this value is retained in presence of various proportions of silver nitrate. At 18° the product has the value $1{\cdot}8 \times 10^{-4}$. T. H. P.

1966. *Attractive Force of Crystals for Like Molecules in Saturated Solutions.* **E. Sonstadt.** (Chem. Soc., Journ. 89. pp. 339–345, Feb., 1906.)—The author finds that when a solution is saturated in contact with a quantity of the solid substance the density of the solution, and therefore the concentration of solute, is greater where there is only a small quantity than when there is a large quantity of solid present; and he also finds that the presence of a large inert surface (glass beads) reduces the concentration. In solubility determinations, therefore, attention must be paid to the amount [presumably only up to a certain limit] of the solid phase in contact with the solution. A. F.

1967. *Molecular Magnitude of some Salts in Pyridine.* **P. Walden** and **M. Centnerszwer.** (Zeitschr. Phys. Chem. 55. pp. 321–348, April 18, 1906. Physik-chem. Laborat. d. Polytechnikums, Riga, Nov., 1905.)

1968. *Relation between Velocity and Volume of Ions of Organic Acids and Bases.* **T. H. Laby** and **G. A. Carse** (Cambridge Phil. Soc., Proc. 13. pp. 288–295, May 15, 1906.)

1969. *Solubility of Haloid Hydrocarbon Derivatives in Water.* **A. Rex.** (Zeitschr. Phys. Chem. 55. pp. 355–370, April 18, 1906. Paper read before the Hungarian Academy of Sciences, Nov. 20, 1905.)—The author gives results of measurements of the solubility in water at various temperatures of a number of halogen derivatives of aliphatic hydrocarbons. He finds, as Winkler found for gases (Zeitschr. Phys. Chem. 9. p. 171, 1892), that with these liquid compounds the diminutions in the absorptive coefficients produced by rise of temperature are equal for compounds containing the same number of atoms in the molecule and having the same molecular weight. The solution of liquids in water is hence an absorption phenomenon.
T. H. P.

1970. *Transition from Crystalline to Colloidal Substances.* **B. Kuriloff.** (Zeitschr. Elektrochem. 12. pp. 209–218, March 16, 1906.)—The author has studied from the standpoint of the phase-rule the interaction of zinc chloride and ammonia in presence of water. The author regards this as an important example for studying the relationship between colloids and crystalloids, and his experiments indicate that whilst the law of mass-action can be applied to a solution in equilibrium with a crystalline compound the law becomes inapplicable when the solid is a colloid, since it then possesses the property of absorbing variable amounts of the salts present in the solution. T. M. L.

1971. *Abnormal Course of Solubility Curves in Relation to Hydrate Formation in the Liquid Solution.* **J. J. van Laar.** (Zeitschr. Phys. Chem. 54. pp. 750–758, March 13, 1906.)—A discussion of the abnormal solubility curves obtained by Roozeboom and Aten [Abstract No. 835 (1906)]. A. F.

1972. *Dissociation of Molten Bodies.* **R. Kremann.** (Zeitschr. Elektrochem. 12. pp. 259–263, April 6, 1906.)—The existence of a state of equilibrium can be shown by the addition of one component to the molten compound, the depression in the freezing-point of which is then smaller than would be expected from the amount of the addition. The method of calculation of the extent of the dissociation previously used by the author [see Abstract No. 863 (1905) requires modification, as has been pointed out by Roozeboom. Even when this is done, the numbers obtained are only approximate, since it is assumed that the gas laws hold in the molten mixture. T. H. P.

1973. *Application of Raoult's Laws to Molecular Weight Determinations in Mixed Solvents and in Simple Solvents whose Vapour Dissociates.* **G. N. Lewis.** (Amer. Chem. Soc., Journ. 28. pp. 766–770, June, 1906.)—Starting from the equations of Raoult for the lowering of the vapour pressure and the raising of the boiling-point of a simple liquid containing a dissolved substance, the author shows thermodynamically that: (1) The law of Raoult for the lowering of the vapour pressure is applicable to an ideal dilute solution in any constant boiling mixture whose vapour obeys the gas laws. (2) The law of Raoult for the raising of the boiling-point is applicable to an ideal dilute solution in any mixture of constant boiling-point.
T. H. P.

1974. *Solvent Properties of Solutions* [*Löslichkeitsbeeinflussung*]. **M. Levin.** (Zeitschr. Phys. Chem. 55. pp. 513–536, June 8, 1906. From Dissertation, Göttingen. —A discussion is given of previous observations on the solvent properties of solutions, and fresh experiments on the solubility of picric acid are described. Electrolytes decrease the solubility of picric acid in water, the effects produced being greater than those resulting from the interaction of electrolytes with non-electrolytes. The ions are therefore specially active in this respect; the action of different anions on the solubility of picric acid is similar to that observed in other cases; the kathions arrange themselves somewhat differently. Non-electrolytes are almost without influence. T. M. L.

1975. *Solubility of sparingly Soluble Substances.* II. *Solubility of Silver Chloride, Bromide, and Thiocyanate at* 100°. **W. Böttger.** (Zeitschr. Phys. Chem. 56. pp. 83–94, July 17, 1906.)—The author has determined the solubility by conductivity methods, and finds the following values: AgCl, 153×10^{-6}; AgBr, 20×10^{-6}; AgSCN, 39×10^{-6} equivalents per litre. [See also Abstract No. 912 (1904).] A. F.

1976. *Electrolytic Calcium.* **L. Doermer.** (Ber. Deut. Chem. Gesell. 39. pp. 211–214, 1906.)—When electrolytic calcium in the form of powder or shavings is struck on an anvil explosions take place. These explosions appear to be due to the presence of oxide of iron. [Compare Goodwin, Abstract No. 859 (1905).]

1977. *Contact Charge between a Porous Partition and Salt Solutions.* **E. van der Ven.** (Archiv. Musée Teyler, 10. pp. 85–108, 1906.)—A study of the electric contact charge by means of electric osmosis. A. F.

1978. *Separation of Energy Losses in Voltameters.* **C. Bäumler.** (Zeitschr. Elektrochem. 12. pp. 481–484, July 13, 1906.)—A method for determining the polarisation of a voltameter by means of an alternating current has been given by Wien [Pogg. Annalen, 58. p. 37 (1896)]. It is found that an increased consumption of energy occurs in the voltameter, this being explicable as due either to an increase of the resistance or to spontaneous depolarisation. The latter explanation is the one usually accepted, but no experimental proof of its truth has been obtained. The author describes a means for deciding this point which, however, he has not tested practically. T. H. P.

1979. *Electrolysis of Potassium Ethyl Dipropylmalonate.* **D. C. Crichton.** (Chem. Soc., Journ. 89. pp. 929–935, June, 1906.)—A 50 per cent. aqueous solution of potassium ethyl dipropylmalonate was electrolysed in a nickel crucible; a spiral of platinum was used as an anode, the current was about 2·5 amps., and the temperature was below 30°. The products of the electrolysis were the ethyl esters of α-propyl-β-ethyl-acrylic acid, dipropylglycollic acid, tetrapropylsuccinic acid, and probably dipropylacetic acid. D. H. J.

1980. *Electrolytic Preparation of Vanadous Salts; Properties of Vanadous and Vanadic Salts.* **L. Marino.** (Zeitschr. Anorg. Chem. 50. I. pp. 49–52, July 9, 1906. Lab. di Chim. Farm. di R. Ist. di Studi Superiori, Florence, March 31, 1906. From the Italian.)—In reference to Rutter's communication on the same subject [Abstract No. 987 (1906)] details as to favourable electrolytic conditions are given. The author is of opinion that for the electrolytic reduction of vanadium salts it is not necessary to employ as electrodes metals which exhibit supertension. With a suitable concentration (5–60 per cent. of vanadyl sulphate), a p.d. of 4–5 volts, and a slight excess of sulphuric acid maintained in the liquid, the double ammonium or potassium vanadous salt may be easily obtained in the crystallised condition, when a plain Pt electrode is employed. Cupric sulphate is the best reagent for vanadous salts. D. H. J.

1981. *Electrolytic Potential of some Peroxides.* **A. Mazzucchelli** and **C. Barbero.** (Accad. Lincei, Atti, 15. pp. 35–42, July 1, and pp. 109–113, July 15, 1906.)—The authors have employed the usual Poggendorff compensation method to determine the electrolytic potential of the peroxides of the metals Ti, V, Mo, W, and U; wherever possible the peroxides were examined in acid and in alkaline solution, and as fluorderivatives. The principal conclusion is that the electromotive action of all peroxides, except those of persulphuric acid and Caro's acid, is by preference that characteristic of reducing agents. The electro-affinity of the group to which the peroxide residue —O—O— is united, determines the chemical behaviour of the oxygen. D. H. J.